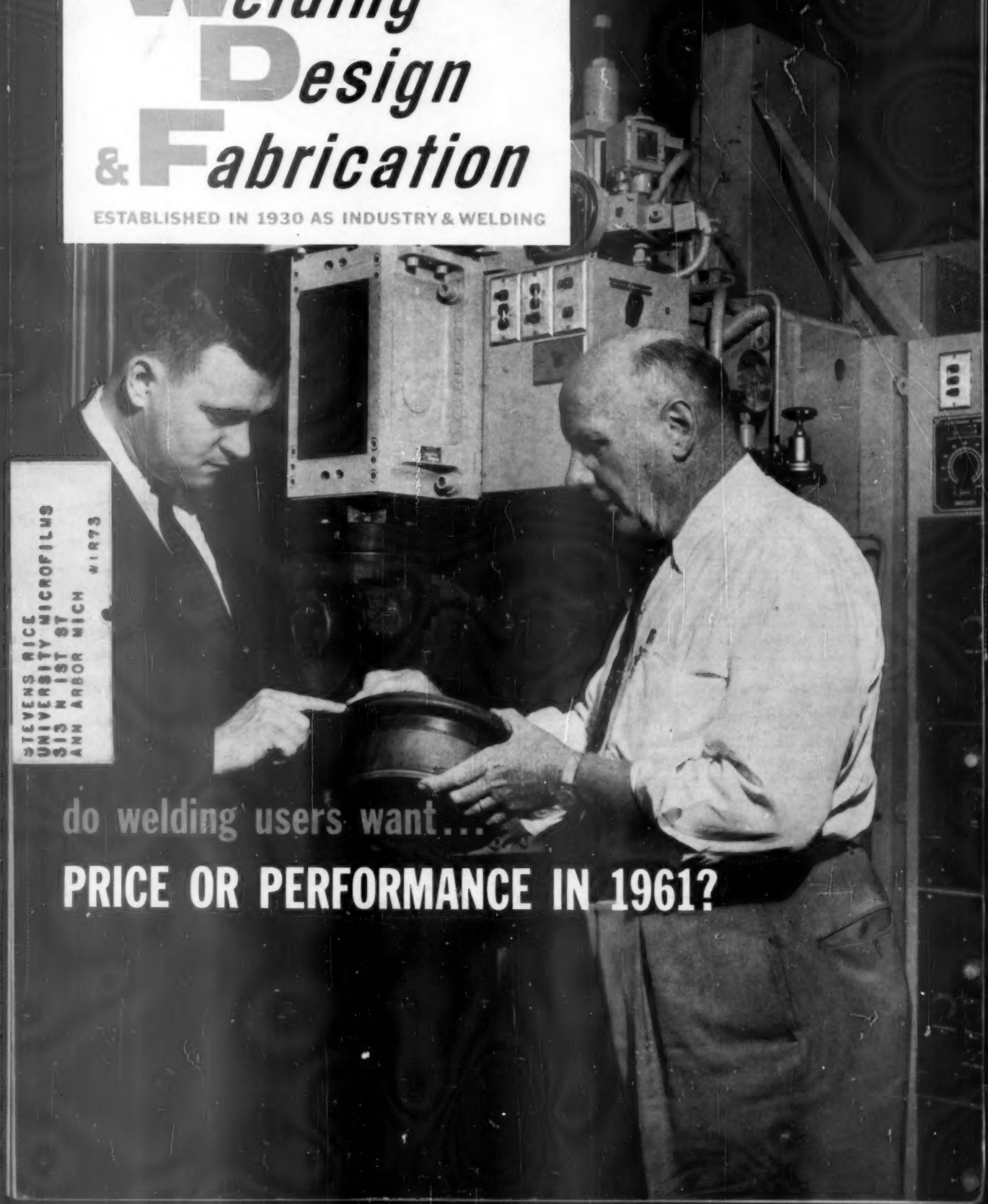
Welding Design & Fabrication

ESTABLISHED IN 1930 AS INDUSTRY & WELDING

JANUARY 1961

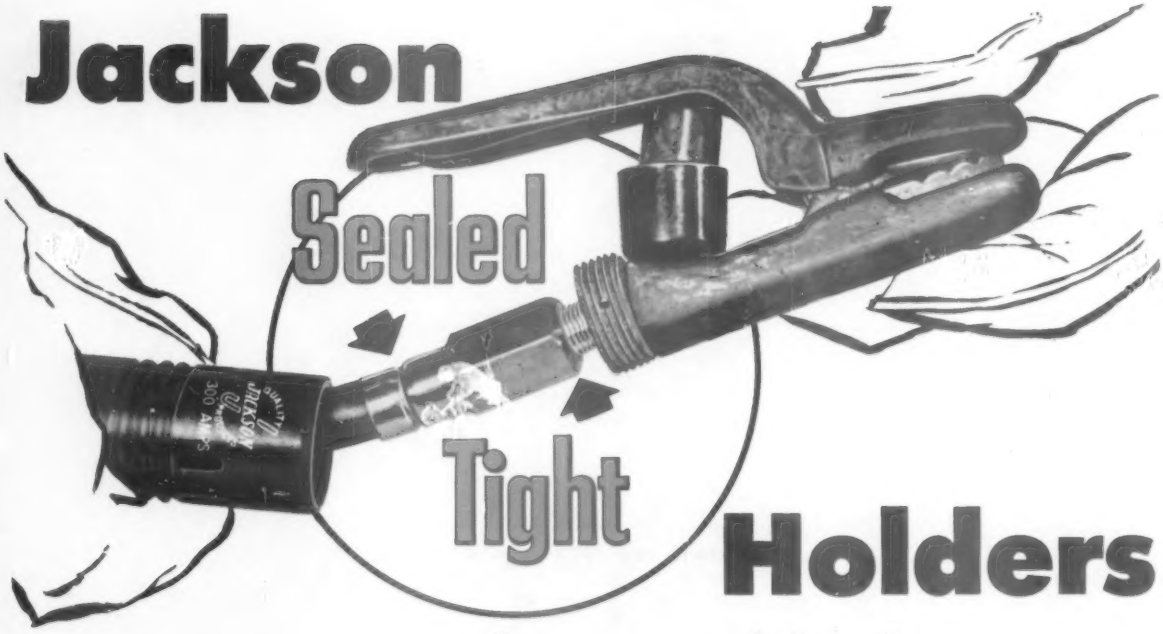


STEVENS RICE
UNIVERSITY MICROFILMS
313 N 1ST ST
ANN ARBOR MICH W1R73

do welding users want...

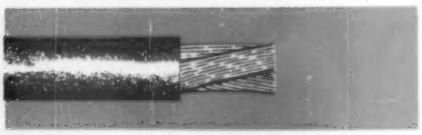
PRICE OR PERFORMANCE IN 1961?

Jackson Sealed Tight Holders

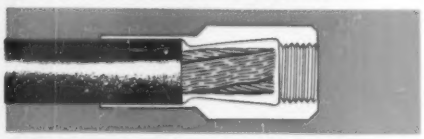


for trouble-free connections

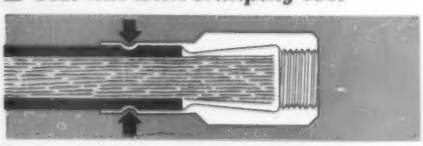
■ *Strip back the cable jacket–*



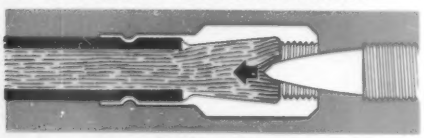
■ *Slide on the connection nut–*



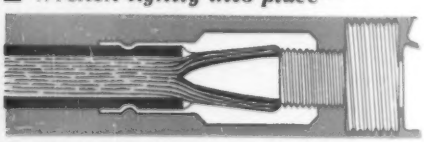
■ *Seal nut with crimping tool–*



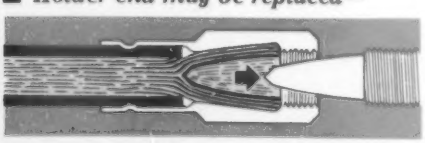
■ *Push holder stud into strands–*



■ *Wrench tightly into place–*



■ *Holder end may be replaced–*



■ *Connection assembly stays put!*

These copper alloy quality Jackson electrode holders have a permanent-type cable connection device good for the life of the cable. It grips the cable jacket as well as the cable, sealing out moisture and dirt. The jacket can't slip back, the strands won't flex and break. The 'stinger end' of the holder can be replaced repeatedly without remaking the connection.

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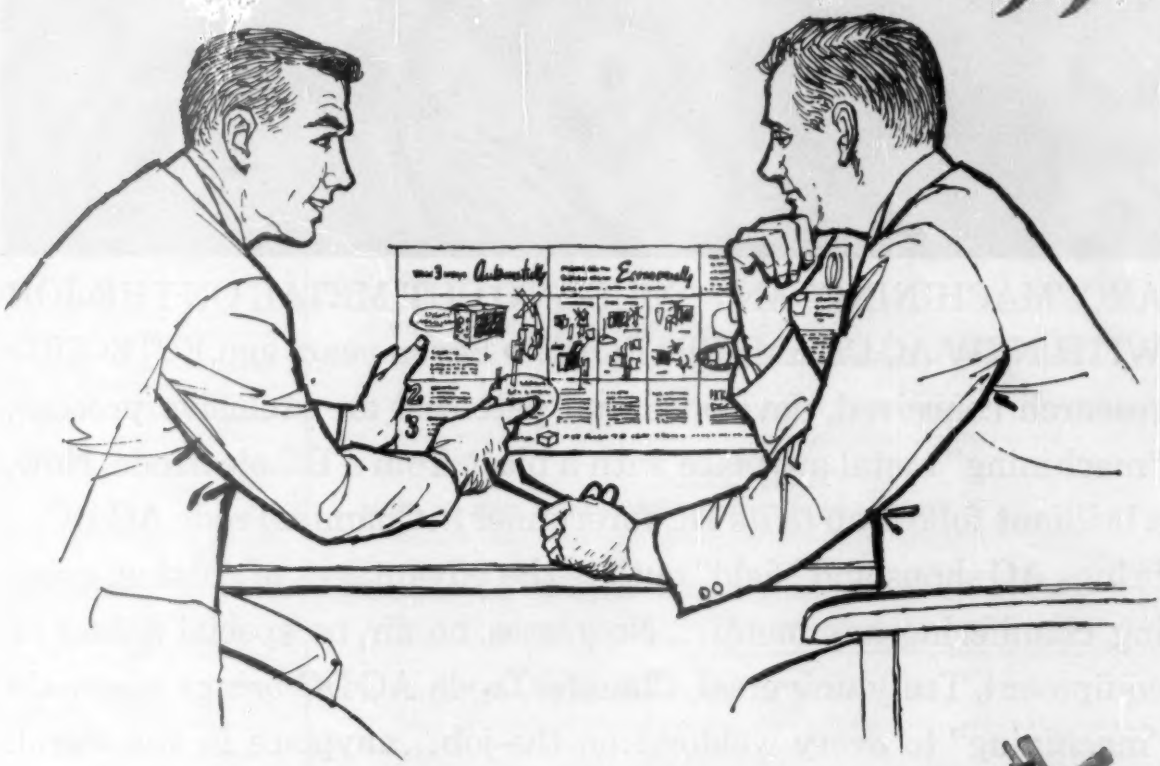

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reader's guide to

for January, 1961

COVER: The editor of WELDING DESIGN & FABRICATION (left) discusses a spot welded product and the machine which made it with Herman Frericks of Spotweld Division, Otto Konigslow Mfg. Company, Cleveland, Ohio. This interview, others like it, and a survey of 500 readers were the basis for the "Price or Performance" article which starts on page 31 of this issue.

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FEATURES

SPECIAL REPORT **DOES INDUSTRY WANT PRICE OR PERFORMANCE IN 1961?**

31 *A cross-section of American industry told us the factors that influenced their choice of welding equipment in the last two years would also influence their buying in 1961.*

34 WELD METAL HAS EXCELLENT PROPERTIES! ARE YOU USING THEM?
Weld metal is stronger than the metal it joins and a welded joint is stronger than any other used for joining metals.

37 HOW TO WELD THE COBALT-BASE ALLOYS
These heat- and corrosion-resistant alloys are welded somewhat like austenitic stainless.

40 UNIQUE DESIGN: 39 STEEL CYLINDERS REPLACE ONE VESSEL
Off-the-shelf tubing replaces a more expensive, large high-pressure vessel in a wind tunnel's air storage receiver.

49 CO_2 WELDING SAVES GENERAL MOTORS $8,000 A MONTH
Automatic welding gives speed, economy, and reliability in making motors.

52 TECHNIQUES FOR FABRICATING AND WELDING ALUMINUM TANK CARS
New welding and cutting processes and techniques have reduced the cost of fabricating aluminum tank cars.

56 FASTER, CHEAPER WELDING OF HEAVY ALUMINUM PLATE
Square-butt welding of 1¼-inch aluminum is done with fewer passes and less total heat input.

58 PUNCHED TAPE WHISKS 27,000 SPOT WELDS INTO POSITION
Tape controls are used in aircraft spot welding where thousands of welds have to be positioned quickly and accurately.

60 FILLER WIRE IS THE KEY TO NEW CO_2 SPRAY ARC WELDING PROCESS
Adjusting filler wire composition gives sound weld metal that can be deposited with an open arc.

64 FOUR METHODS FOR BRAZING B-70 STAINLESS HONEYCOMB PANELS
North American Aviation investigated four possible methods for brazing the B-70's stainless honeycomb panels; they finally picked all four.

66 NICKEL-SILVER BRAZING SAVES $2,600
Repairing a worn bull gear also eliminated a 4-month wait for a replacement part.

DEPARTMENTS

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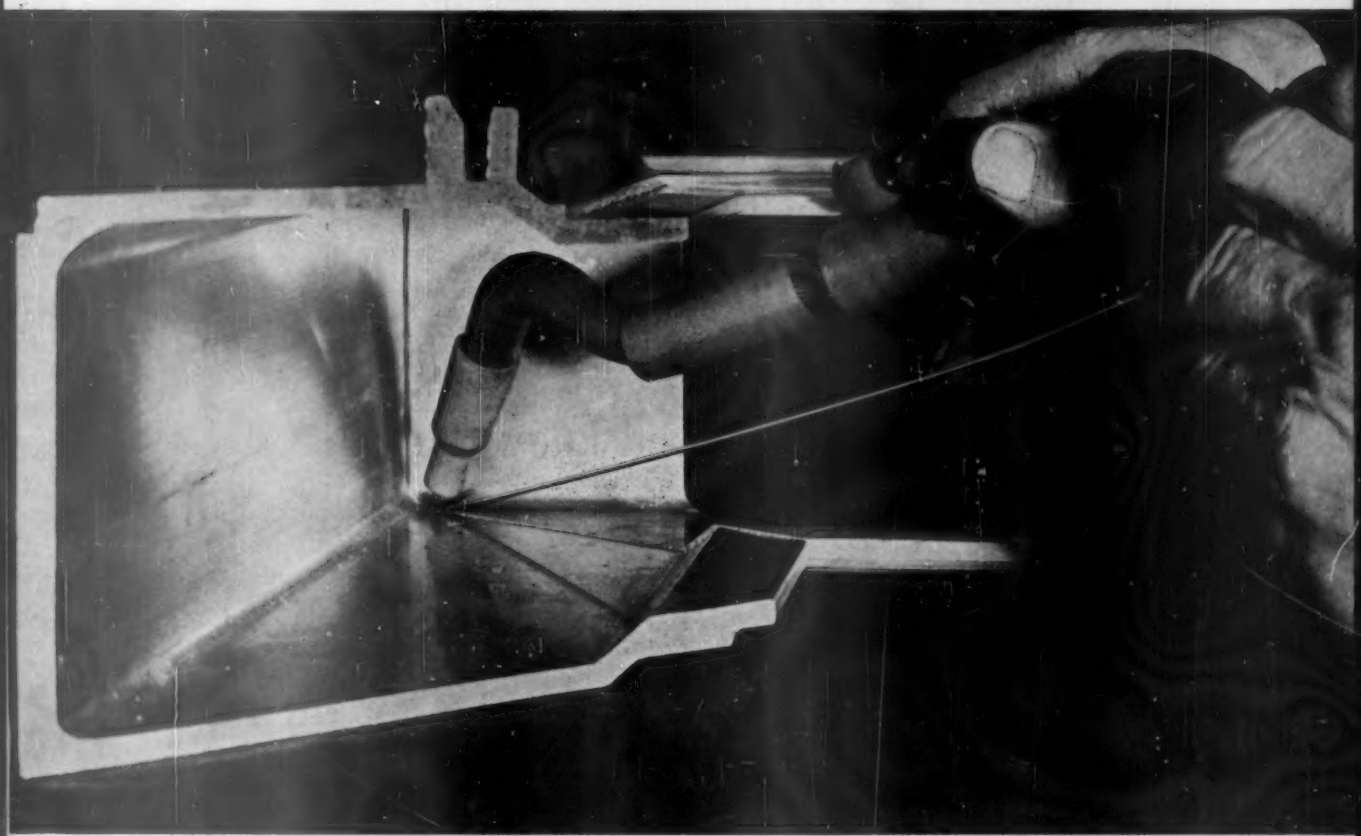

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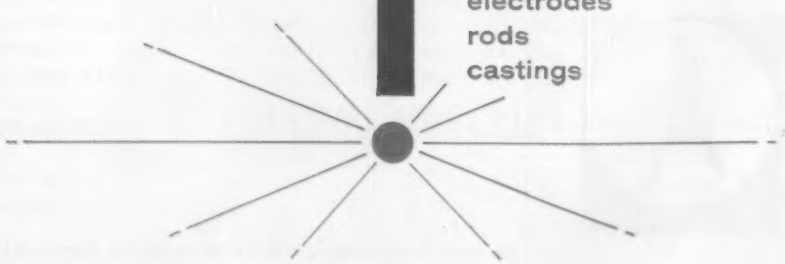

TWENTY YEARS OF LEADERSHIP IN THE DEVELOPMENT OF QUALITY ALLOY ARC WELDING ELECTRODES

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LETTERS

to the editor

ELECTRODE COATING

Editor:

The October issue of WELDING DESIGN & FABRICATION mentions organic resin bonding agents replacing water glass in arc welding electrode coatings. Would you please tell us the Russian publication from which this information was taken?

A. E. Wiehe
metallurgical engineer
The McKay Company
York, Penna.

● *The Russian publication in question is: Mazel, A. G., Svarochnoye Proizvodstvo, No. 5, 1960, 25-28.*

Material of this sort is abstracted by Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Abstracts are sold on subscription at $7 for six months.

Watch our Welding Management section each month for other information on new developments in Russian welding. For an overall view of the Russian welding picture, see WD&F's August, 1959, issue, page 27.

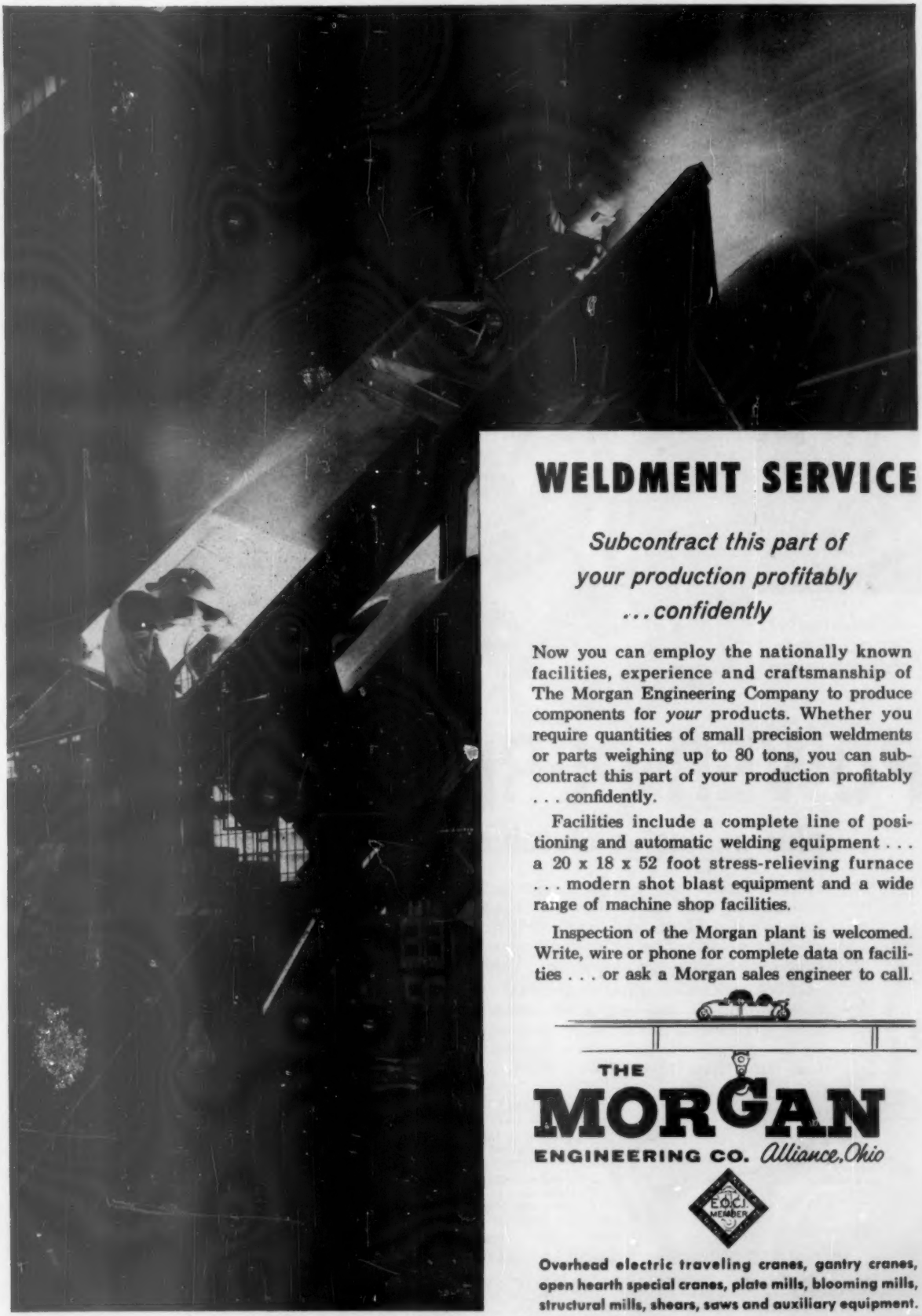
RADIOGRAPHED VESSELS

Editor:

There is a very fine article in the November, 1960, issue of your magazine, entitled "Does A Radiographed Vessel Cost More to Build Than One That Isn't?" We would like to obtain a quantity of reprints or tear sheets of this article, to be used in a mailing to customers and prospective customers in our area. Can we obtain approximately 200 copies of the article and, if so, at what cost to us?

Henry C. Seeboth
president
Larpen Industries, Inc.
Milwaukee

● *There are tear sheets of the radiography article available, plus complete copies of the November issue at $.75 each. We have already ordered thousands of reprints of this article for our readers.*



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MEN ON THE MOVE

in the welding industry

APPOINTMENTS:

WING

BERNARD

Pete Wing has been appointed district representative in northern Illinois for Milwaukee Electric Tool Corp. He succeeds **Thomas Langdon** who will become sales manager in Arizona, New Mexico, and western Texas.

W. H. "Barney" Bernard has been named assistant chief engineer of the Welding Division, Omark Industries, Inc., Portland, Oregon. He will do research work on stud welding at the company's Cincinnati office.

Metal & Thermit Corp. has made the following appointments:

Charles F. Delbridge is product manager, welding equipment and accessories, Rahway, New Jersey.

Robert E. Casick is welding sales engineer out of the Chicago office.

Harold W. Mears is regional sales manager, Welding Products Division, Rahway, New Jersey.

George M. Walberg is welding machine specialist, Welding Products Division, Rahway, New Jersey.

The Norton Co., Worcester, Mass., has announced the following appointments:

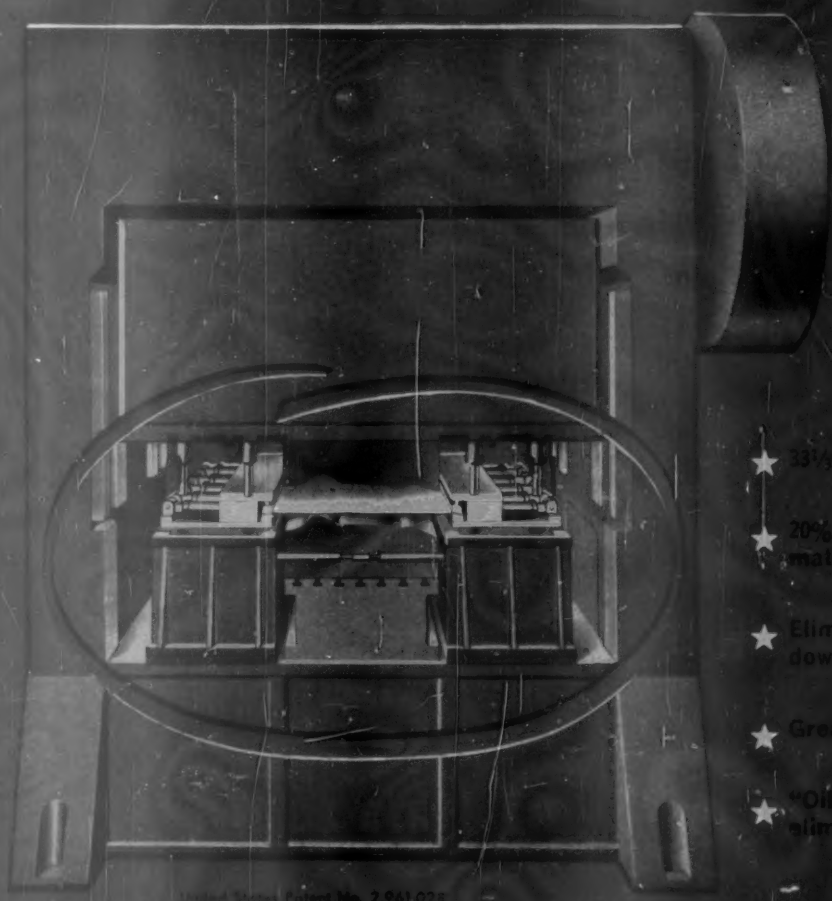
Winton A. Vagedes is Cleveland District Manager of their Abrasive Division. He succeeds **Cheever H. Ely** who has been selected for a special assignment in the New England District.

John M. Esten has been appointed abrasive engineer in the New Jersey area. **Karl E. Krogstad** will succeed Esten as abrasive engineer in Philadelphia.

continued on page 12

NEW... IT'S REVOLUTIONARY...

Stretch Forming and Standard Draw Press Work COMBINED!!



- ★ 33⅓% saving in die cost
- ★ 20% saving in sheet material cost
- ★ Eliminates the hold down ring
- ★ Greater Part Accuracy
- ★ "Oil Canning" eliminated

United States Patent No. 2,961,028

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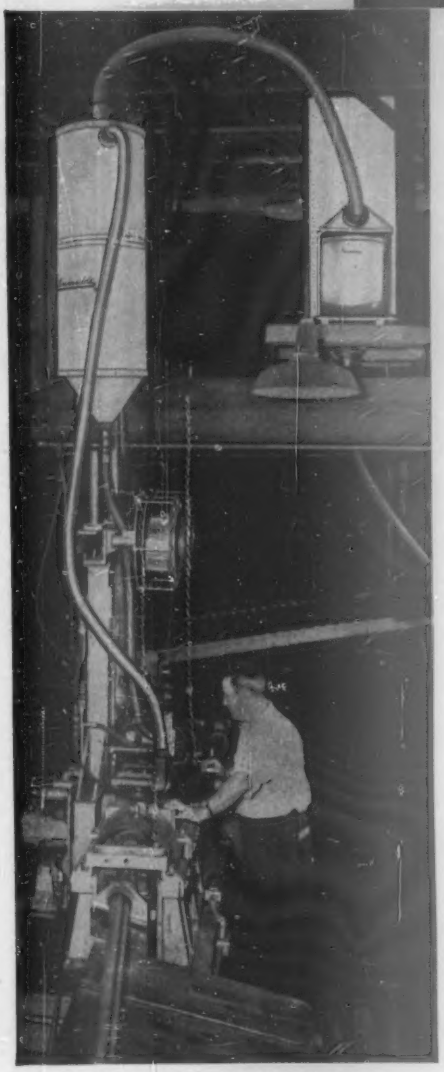
This new Cyril Bath, Tension Controlled Blank Holder, for shallow draw press operations stretches the metal slightly prior to conventional forming. Pre-stressing makes the metal flowable, reduces springback and parts are formed with extreme accuracy to the matching die. Oil canning, wrinkles and trapped air pockets are eliminated. The hold down ring is completely eliminated, so [illegible] is greatly reduced.

For Press users and potential Press buyers it is a must to investigate this new and outstanding development. Literature is available [illegible]

For More Information Circle No. 23 on Reader Service Card.

Savings in reclaimed flux alone have paid for Invincible units in a few months, or even weeks, on submerged arc welding jobs.

INVINCIBLE
Welding Flux Recovery Systems
MAKE 3-WAY SAVINGS



Operating continuously, this Invincible recovers all unfused flux from pipe-seam welding operation at a leading automotive firm.

1 *Valuable Flux Reclaimed. Automatic* Invincibles recover *all* unfused flux and return slag-free, dust-free usable flux to the welder — *all in one continuous operation.*

2 *Costly Man-Hours Saved.* Invincibles do the complete job automatically — far more swiftly and efficiently than manual methods.

3 *Fewer Expensive Rejects.* Invincibles remove all fine dust (flux flour), thus reducing welding rejects and speeding production.

Many Important Advantages

- Ruggedly built to resist abrasive nature of flux.
- Compact and lightweight. Variety of models and flexibility eliminate need for tailor-made installations.
- Portable units also available.

WRITE TODAY FOR FOLDER on Invincible Flux Recovery Systems.

INVINCIBLE VACUUM CLEANER MFG. CO.
DOVER, OHIO

For More Information Circle No. 47 on Reader Service Card.

MEN ON THE MOVE

continued from page 10

PROMOTIONS:

REINGARDT

WAKEFIELD

H. Brown Reingardt succeeds **E. J. Nist** as eastern sales manager for the American Manganese Steel Division of American Brake Shoe Co. Nist is retiring.

Willard W. "Bill" Wakefield has been named sales manager of the C. B. Herrick Mfg. Corp., Cleveland. He has been chief engineer for the past five years.

Charles G. Chisholm has been appointed vice-president—marketing of Haynes Stellite Co., division of Union Carbide Corp. He had been general sales manager for 4 years.

Tube Turns Division of Chemetron Corp., Louisville, promoted the following regional managers.

Atlantic (New York): **S. M. Hardison.**

North Central (Pittsburgh): **Herbert P. Smith.**

Northern (Chicago): **J. C. Ellsworth.**

Southeastern (Atlanta): **James F. Craig Jr.**

Central (Louisville): **E. R. Muir Jr.**

Midwestern (Kansas City): **L. D. Hall.**

Mid-Continent (Tulsa): **L. O. Morris Jr.**

Southwestern (Houston): **W. B. Whenthoff.**

Pacific (Los Angeles): **N. P. Bosemer.**

Arthur Hill is a new sales engineer in Cleveland for A. O. Smith Corp. **Vernon H. Hartley** moves into Hill's former position in the Louisville, Ky. sales office.

continued on page 14

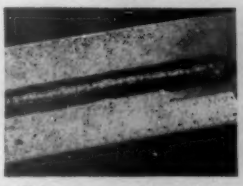
TOTALLY NEW AIR TOOL

Hogs, Blends, Finishes Metal Faster!

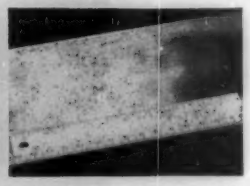
ARO Portable Belt Grinder

You're looking at a new ARO Belt Grinder in action. In this all-new production tool, Aro has combined the backstand idler principle of abrasive grinding with *portability* and *power* to remove metal faster. Live action of the coated abrasive belt running at high speed over slotted, resilient rubber contact wheel sets the abrasive grains "on edge" to give more bite. The metal is actually *sheared* off! Action is smooth and true—no chattering, bumping or bouncing. And you can rough grind and finish in one operation, because the abrasive belt method doesn't leave gouges or swirls in the work. Free belt stropping of corners and radii is easy, too. Beat high grinding costs with new Aro Belt Grinders. Job test one. Ask your Aro Distributor.

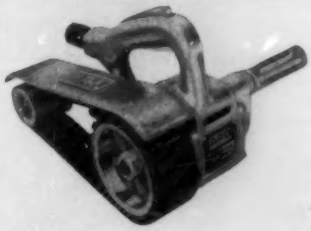
Cuts Metal like Butter!



1 Take a rough 6" weld like this. Put a powerful Aro Belt Grinder on the job, and take the grind out of grinding! Full 2 H.P. air motor running at 6000 R.P.M. produces 7000 S.F.P.M. Belt speed—you hog and finish in one operation.



2 Here's the result just 1¼ minutes later, using a 24-grit belt. This is typical of the outstanding performance you can expect from the new portable Aro Belt Grinder—only tool of its kind—unbeatable for grinding performance.



ARO®

AIR TOOLS

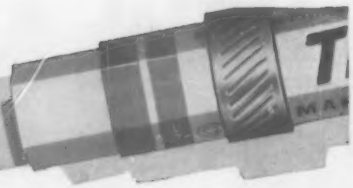
AIR HOISTS • AUTOMATION TOOLS
ULTRASONIC CONTROLS

THE ARO EQUIPMENT CORPORATION
Bryan, Ohio

Aro of California, 3141 S. Grand Avenue, Los Angeles 7, California; Aro Equipment of Canada Ltd., Rexdale (Toronto), Ontario
Offices in all Principal Cities

For More Information Circle No. 20 on Reader Service Card.

THIS MARK



tells you the temperature!

NEW *Markal*®

A STIK FOR EVERY TEMPERATURE FROM 113°F TO 2000°F

THERMOMELT TEMPERATURE INDICATORS

JUST MARK OR STROKE ANY SURFACE TO BE HEATED . . .

with a handy MARKAL THERMOMELT Stik. When the mark melts, your temperature has been reached. Choice of 65 exact (plus-minus 1%) temperatures from 113° F. to 2000° F. THERMOMELT's also available in Liquid and Pellet for difficult or hard-to-measure spots . . . same wide range of temperatures. Make sure you're always right on the button . . . make sure you use MARKAL THERMOMELT for precision temperature indicating.

EASY-TO-USE ADJUSTABLE METAL HOLDER AND DISPENSER

SEND FOR new Markal Thermomelt brochure and free sample pellets. Please state temperature requirements.

Available at your Welding and Industrial Distributor

MARKAL COMPANY

3063 West Carroll Avenue • Chicago 12, Illinois

For More Information Circle No. 75 on Reader Service Card.

MEN ON THE MOVE

continued from page 12

PROMOTIONS:

Richard F. Sanford is a recent addition to A. O. Smith's Detroit sales office.

George E. Parker has been named assistant sales manager of Cincinnati Milling Machine Co.

Charles E. Reichel takes over Parker's former position as Chicago District sales manager.

Robert L. Westrum is sales manager for the new O.E.M. sales department of Onan Division of Studebaker-Packard Corp., Minneapolis.

William R. Schneider is in charge of a new Commercial Welded Products Department at D. S. Kennedy & Co., Cohasset, Mass. He was formerly manager of planning and control.

Cecil Milne joined the sales staff of Fabriform Metal Brazing, Los Angeles.

HONORS:

James Finney Lincoln, chairman of the board of The Lincoln Electric Co., Cleveland, was presented the James H. McGraw Award Manufacturers Medal for his "outstanding leadership and inspiration in the creation and development of the electric arc welding process and industry." The medal was presented at the 34th annual meeting of the National Electrical Manufacturers Association.

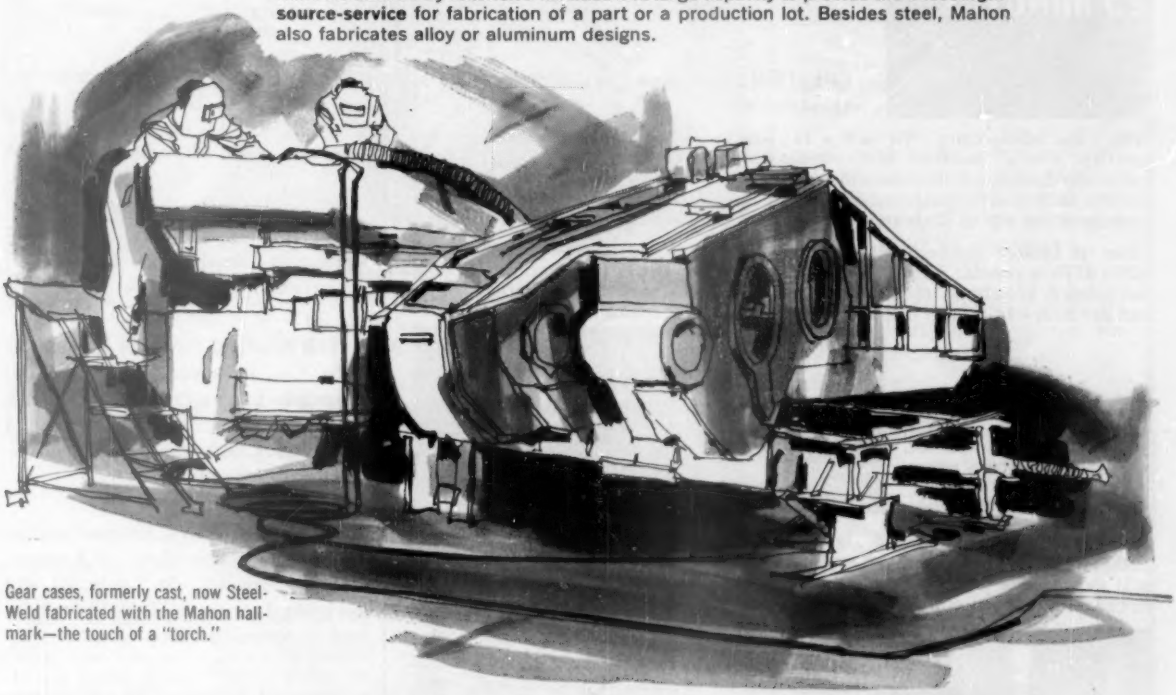
James C. Cox received the George N. Sieger Award for outstanding service to the Detroit Section of the American Welding Society. Mr. Cox, who just retired, helped found S-M-S Corporation, and was its president since 1953.

continued on page 16

MEN WHO KNOW
FACILITIES, CAPACITY
AND **EXPERIENCE,** BUY...

"fabrication by Mahon"

Unmatched experience . . . from fabricating hundreds of thousands of parts of all types, both mechanical and structural . . . has sharpened old-time craftsmanship into a modern production art, uniquely applied by Mahon's Steel-Weld Division. No matter what kind of fabrication—welding, machining, or assembling—your parts might require, Mahon's experience is yours at **no extra cost.** This depth of experience is backed by extensive facilities and large capacity to provide the best **single-source-service** for fabrication of a part or a production lot. Besides steel, Mahon also fabricates alloy or aluminum designs.



Gear cases, formerly cast, now Steel-Weld fabricated with the Mahon hallmark—the touch of a "torch."

Non-destructive radiographic inspection insures highest quality work by Mahon—Master of Metals.

WRITE TODAY FOR NEW STEEL-WELD LITERATURE . . . OR, FOR ON-THE-SPOT HELP, DISCUSS YOUR DESIGN REQUIREMENTS WITH A MAHON FABRICATION ENGINEER

THE R. C. MAHON COMPANY · DETROIT 34, MICHIGAN

Manufacturing Plants—Detroit, Michigan and Torrance, California

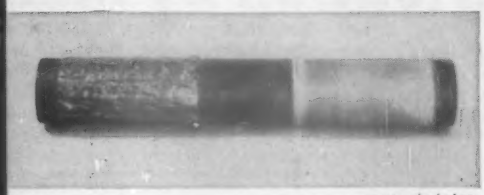
Sales-Engineering Offices: Detroit, Chicago, New York, San Francisco and Torrance

MAHON

For More Information Circle No. 55 on Reader Service Card.

HARD FACING TIME CUT FROM 4 HOURS TO 25 MINUTES

The two end sections of this shaft have been built up with AMS 4775. Section at left applied by welding – time 4 hours; section at right by flame spraying – time 24 minutes, 45 seconds.



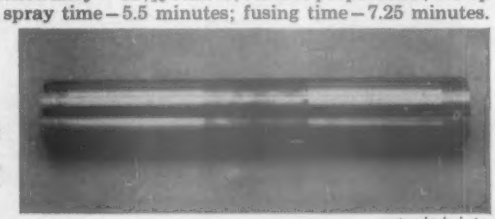
unretouched photo

QUESTION: And which end would you prefer to grind finish?

Here's the whole story. We took a 15" length of 2.5" mild steel shafting and undercut two 5" sections .050" on the radius. We then sent the shaft to a nationally-known job shop with instructions to apply AMS 4775 on the left-hand section, sufficient to finish at 2.5". Weight of welded-on alloy was 17 9/16 ounces – time spent by one of their top men – 4 hours (including preparation).

Then we blasted the second section with steel grit and flame sprayed it with AMS 4775 in powder form (ThermoSpray Powder 15E). The coating was then torch-fused. Weight of deposited alloy – 11 5/16 ounces; surface preparation, set-up and pre-heat – 12 minutes; spray time – 5.5 minutes; fusing time – 7.25 minutes.

Finish-ground shaft – welded section at left, flame sprayed section at right.



unretouched photo

We then sent the shaft out to a grinding shop with instructions to clean up at 2.500" plus. The flame-sprayed section cleaned up at 2.510" but welded section still showed pits when grinding was stopped at 2.477" (see photos below left). Rockwell of welded end Rc-61, sprayed end Rc-60.

Note pits in welded section at left. Both magnified about 50x.

These flame-sprayed coatings are solid, homogeneous; usually superior to those applied by other methods. You can apply them at high speed, with lower material and finishing costs. In addition to AMS 4775, a number of other powders – including tungsten carbides – are available for various service requirements; all may be fused–some used as sprayed for certain service requirements.

For further information on this high-speed, money-saving, hard-facing process, phone, write or wire.

Pump plunger being flame sprayed with METCO ThermoSpray Powder Gun

METCO INC.
FORMERLY METALLIZING ENGINEERING CO., INC.
Flame Spray Equipment and Supplies

1179 Prospect Ave., Westbury, L. I., N. Y. Tel.: Edgewood 4-1300 Cable: METCO In Great Britain: METCO, Ltd., Cobham-near-Woking, England

METCO INC.
1179 Prospect Ave., Westbury, L. I., New York

Please send me free bulletin on hard facing.

Name _____

Title _____

Company _____

Address _____

City _____ Zone _____ State _____

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MEN ON THE MOVE

continued from page 14

ELECTIONS:

THAYER

SIMONDS

Les A. Thayer was elected vice-president-sales, Belden Mfg. Co., Chicago, at the November meeting of Belden's board of directors.

The Abrasive Grain Association recently elected **John H. Simonds** (Simonds Abrasive Co.) chairman of their board of directors.

The board of directors of Lummis Mfg. Co., Pasadena, elected **W. R. Lummis** to chairman of the board. **D. R. Lummis** was elected president and **C. H. Clark** was made vice-president and general manager.

William L. Davis has been elected executive vice-president of Emerson Electric Mfg. Co., St. Louis. He will be general manager of the Electronics and Avionics Division.

National Electrical Manufacturers Association has elected its officers for 1961. They are: **A. D. R. Fraser,** president (Alcoa); **W. R. Peterson,** vice president (Emerson Electric Mfg. Co.); **A. E. Pringle, II,** treasurer (Pringle Electrical Mfg. Co.).

The newly elected officers of the Grinding Wheel Institute are:

L. A. Patt, chairman of the board, (Carborundum Co.).

W. G. Pinkstone, president, (A. P. de Sanno & Son, Inc.).

C. F. Leitten, vice-president, (Electro Refractories & Abrasives).

New members of the Board of Directors are **R. C. Franklin** (Macklin Co.); **C. R. Anderson** (Robertson Mfg. Co.); **M. W. Gormly** (Cincinnati Milling Machine Co.); **H. G. Jones** (Mid-West Abrasive Co.).

ONE WELD--
or a Thousand Miles of Them

Magnaflux inspection of weld on refinery reactor during erection.

Speed and ease of Magnaflux speeds pipeline weld tests, and tests 100% of welds!

To get fast -- positive -- low cost inspection

Call MAGNAFLUX
NATION - WIDE
SCIENTIFIC
INSPECTION SERVICE

Anywhere -- Anytime

When you need weld inspection you can depend upon — in the field or in your plant — *call us.* You'll have a Magnaflux factory-trained Commercial Inspector or team on the job — pronto!

These expert men, working with all Magnaflux Test Systems (Magnaflux-Magnaglo, Zyglo, Sonizon Ultrasonic and others), and with Gamma Ray, find every defective weld that *needs* to be found.

The cost — usually a few cents or less per foot of weld! It is just as important to you that they recognize *good* welds as spot the bad ones.

Then, by showing not only *what* and *where,* but *how* defects occur, they help welders do a better job. This cuts your welding costs — assures consistent quality at a practical price.

FOR TESTING BIG THINGS such as pressure vessels, heavy machinery, piping and pipelines, structural members, *Magnaflux Field Inspectors* bring a mobile "shop" right to the site.

IN THE FIELD OF NUCLEAR ENERGY, this test service offers the most positive detection known for locating the weldment leaks that are of such vital concern. In any kind of maintenance inspection Magnaflux Test Systems mean safety.

FOR SMALL PARTS WELDMENTS, use your nearby *Magnaflux Commercial Inspection Plant.* Testing here is low in cost for any quantity—gives you the benefit of a *nation-wide standard inspection* that helps you build welding business through accepted evidence of quality. Write for new bulletin.

TO GET, USE OR BUY BETTER WELDING AT LOWER COST — write for details . . .
or call any of the COMMERCIAL INSPECTION BRANCHES SHOWN BELOW

MAGNAFLUX CORPORATION
A Subsidiary of General Mills
7348 West Lawrence Avenue, Chicago 31, Illinois

HALLMARK OF QUALITY IN TEST SYSTEMS

Mineola, L.I., N.Y. Pioneer 7-3220	Pittsburgh 36 TUxedo 2-3448	Indianapolis 18 LIberty 7-1303	Houston 21 WAlnut 3-9169
Newark 4, N. J. HUmbolt 3-1235	Cleveland 15 HEnderson 2-0727	Chicago 39 EVerglade 4-1561	Oakland 8 OLympic 8-0201
E. Hartford, Conn. BUtler 9-2737	Cincinnati 23 MUlberry 1-6436	Los Angeles 22 Raymond 3-8961	Van Nuys STate 5-8640
Philadelphia, 40 DAvenport 9-4070	Detroit 11 TRinity 3-4343	Dallas 35 FLeetwood 2-2626	

OR DO-IT-YOURSELF
with your own
MAGNAFLUX TEST SYSTEMS

If you do production weld testing or other frequent weld tests in your plant or on-site, it may be to your advantage to own your own Magnaflux testing facilities. You select from the systems and methods used by industry for practically every weld testing need. You also get the benefits of complete cooperation from Magnaflux Field Engineers, the entire Magnaflux engineering staff and research group in establishing the tests, methods and techniques to give you the results you are looking for in each specific application. You enjoy a free consulting service from top authorities—at no extra cost. COMPLETE PORTABLE KITS START AS LOW AS $36.00.

Included are completely automated systems for any Magnaflux method or production process, including:

MAGNAFLUX-MAGNAGLO®

The only recognized test proven completely reliable for finding all cracks in magnetic weldments open to the surface. For linear weld, costs about 4.4c per foot. Unit prices start as low as $195.

ZYGLO®

Fluorescent penetrant. Standard, broad-use tests for nonferrous metals, stainless steel, etc., with 100% reproducible results at any degree of sensitivity you require. Complete kits, including black light, only $125.

MAGNATEST®

Eddy current tests for control of welding of nonmagnetic metals by conductivity measurement of heat affected zones. Also separate mixed alloys, check heat treat over entire assemblies with noncontact probe.

SPOTCHECK®

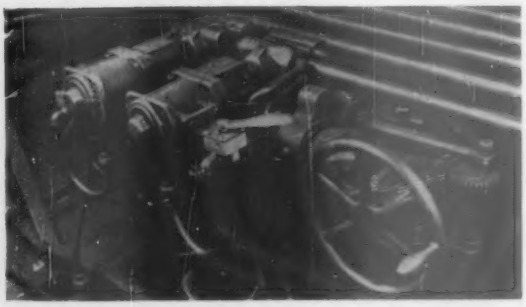
Dye penetrant testing in its most convenient form, with all materials in spray cans—high-flash, nonflammable or chlorine-free. Complete portable kits, $36. Low cost kit replacement materials and in bulk.

Write today for full information or for discussion of your needs.

For More Information Circle No. 54 on Reader Service Card.

WELDING MANAGEMENT

watches these developments



THE OLDEST KNOWN resistance butt welding machine still in use in this country (see photo) is the one Rempe Co., Chicago, bought almost 75 years ago from Thompson Electric Welder Company, Lynn, Mass. Until last year, when the regular operator (for 52 years) retired, the 25-kva, hand-operated machine was still welding heating and refrigerating pipe coils in black iron pipe. The welder is used only occasionally, now.

Surprisingly enough, the 1896 welder was equipped with air clamps and water-cooled dies.

USE OF FOREIGN structural steel in Southern cities is facing trouble. A new program adopted by the Southern Building Code Congress (a group of 500 municipal officials who police the standard building code in 900 cities and towns) will require that foreign steel be tested in a laboratory approved by ASTM. The Congress will continue to assume automatically that domestic steels meet standards. The action was taken because of several recent failures in structural steel construction where foreign steel was suspected because of laxity in enforcing the SBCC rules.

A NEW TRAINING CENTER for plumbing and pipe fitting apprentices has been dedicated at Norfolk, Va. The center, called the most modern in the country, is a result of a cooperative effort by labor and management. At the dedication ceremonies, electric and gas welding and cutting equipment, supplied by the NCG Division of Chemetron Corp., was previewed.

FRICTION WELDING, which converts the mechanical energy of metal, ceramic, or plastic parts revolving in contact with one another into heat, and then a weld, is coming in for intensive study at American Machine & Foundry Co., Stamford, Conn.

Main aim of researchers is to dig up new facts about the old concept of friction welding and to find practical applications for the process. Already they've found evidence that a layer of fluid metal is formed between parts, something that wasn't known before.

A NEW PACKAGE—called Barrier Carton—has been adopted by Air Reduction Sales Company to insure shipment of fresh, dry, low-hydrogen electrodes to customers. Carton has an inner layer of aluminum foil in the corrugated cardboard which is said to make it about nine times more resistant to moisture than ordinary cartons.

A REMARKABLE NEW ENGINE whose block is made of thin, brazed stainless steel sheets was unveiled at the 15th annual convention of the American Society of Body Engineers in Detroit recently. The four-cylinder engine combines high power with lightness, and durability. For instance, one model delivers 175 hp, yet weighs only 175 lbs.

The main reason for the engine's performance is the use of brazed, thin Type 302 stainless sheets for the block assembly, including combustion chambers, water jacket, intake and exhaust ports, upper block pan and spark plug tubes. The stainless does away with corrosion worries, while the thin stampings used (some are as thin as a penny) dissipate heat faster than a cast block.

The engine was designed by Lloyd Taylor and is produced by Tyce Engineering Corp., Chula Vista, Calif.

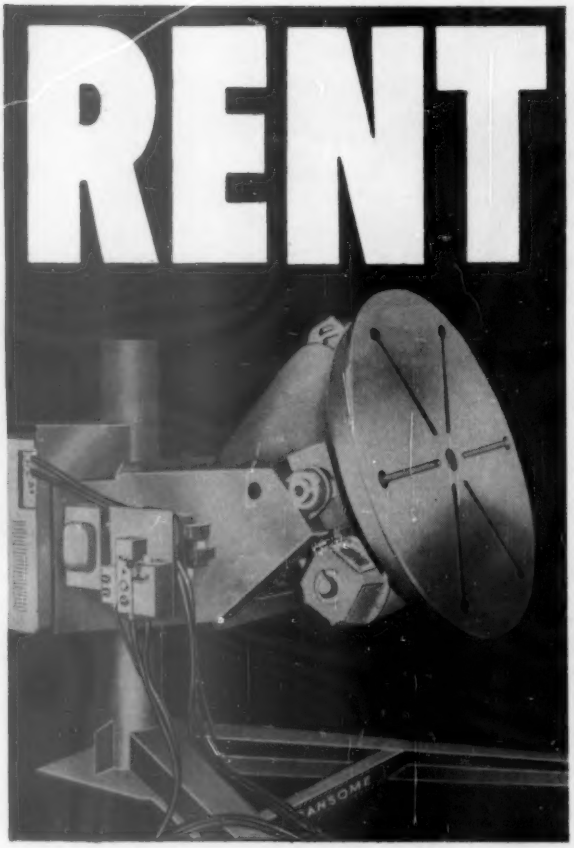
TWO NEW FILMS, for 16 mm full color and sound showing are available to industry on a free loan basis.

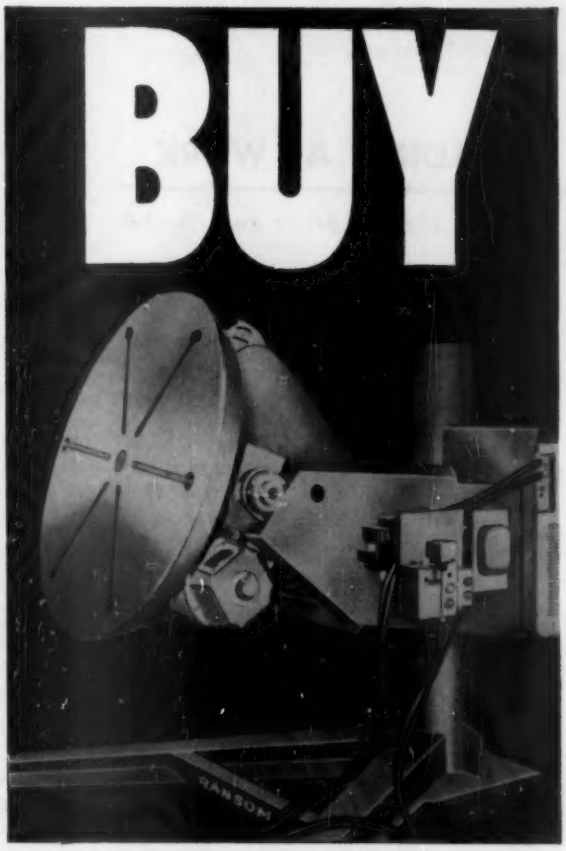
"Industrial Gases And Shielded Arc Welding" issued by Air Reduction Sales Co., is a 27-minute show which correlates the story of oxygen, nitrogen, hydrogen, argon, and carbon dioxide with welding applications.

"How To Locate Flaws with Dye Penetrants", issued by Turco Products, Inc., is a training film which demonstrates dye penetrant inspection from laboratory theory to production-line techniques.

RESISTANCE WELDING equipment shipments for October have passed the $2-million mark for the ninth consecutive month, according to the Resistance Welder Manufacturers Association. Shipments for the first 10 months of 1960 were reported 18½% ahead of the same period in 1959.

BUSINESS IS GOOD according to 206 distributor members of the National Welding Supply Association. They said they sold 4% more welding supplies in the third quarter, 1960, than they did in the same period of 1959. In comparing sales for the first nine months of 1960 with the same period in 1959, the Association found that members sold 7% more.





RANSOME MAKES IT EASY FOR YOU TO CUT HANDLING COSTS!

You can have the Ransome positioning equipment you need . . . any way you want it!

MAIL COUPON NOW

Of course, our business is **selling** equipment . . . but, now with **Ransome's exclusive rental or rental-purchase plans** you can always have exactly the positioning equipment you need, when you need it, for as long as you need it.

Use of the proper positioning equipment on a job often spells the difference between profit and loss on that job . . . or even between getting and not getting the job in the first place.

Now . . . for the first time in welding history, you can bring exactly the equipment you need for any job into your shop . . . and keep it there only while it's making profits for you.

No need to tie up large amounts of capital. Ransome's low rental fee can be charged directly to a contract, and **can be written off as an operating expense.** The equipment is out of your shop as soon as its work is complete. It does not sit idle, wasting space, adding overhead. No need to pass up any job because of lack of sufficient positioning equipment. You can figure positioning . . . and the savings positioning brings . . . in your estimating for all jobs, big and small, long-term and short-term.

To learn more about Ransome's "pay-as-you-profit" rental or rental-purchase plans fill in the coupon.

RANSOME COMPANY
Scotch Plains, New Jersey

☐ I am interested in renting Ransome Equipment: Please quote rates for: Type:_____ size or capacity:_____

☐ I anticipate requiring this equipment on or about_____

for approx._____ ☐ months ☐ weeks

☐ Have sales engineer contact me ☐ Send Ransome literature

☐ Send FREE GUIDE to Positioning Equipment

Name:_____

Company_____

Address_____

City_____ Zone_____ State_____

Ransome Company

Division of Big Three Welding Equipment Co.
SCOTCH PLAINS, New Jersey

RANSOME...THE PIONEER IN POSITIONING FOR WELDING

For More Information Circle No. 64 on Reader Service Card.

WELDING AT WORK

to do the job better and cheaper

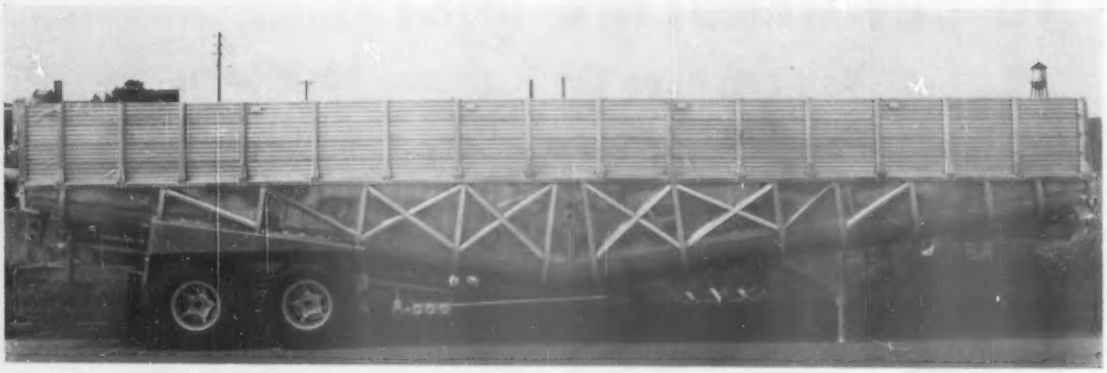
Mild steel replaces stainless drive shaft

DETROIT: This outboard motor drive shaft projects 6 inches into the water during normal use. It was originally machined from solid type 400 stainless for corrosion resistance.

To reduce costs, it is now a mild steel shaft whose front 6 inches are protected with an overlay of Nicrocoat No. 3 alloy at the Wall Colmonoy Corporation's Detroit plant.

The alloy is applied to the finish machined mild steel shaft by cold spraying to produce a coating 0.001-inch to 0.0015-inch thick. The coated shaft is then placed in a controlled atmosphere furnace where the overlay is fused to the shaft with a molecular bond.

The mild steel shaft now has the corrosion resistance and the wearability of stainless but costs 52 per cent less to produce.



Welded aluminum trailer hauls liquids and dry payloads

NORTH KANSAS CITY, MO.: This dual cargo trailer can carry a liquid load or a dry payload of 42,600 pounds. Its underslung aluminum tank carries up to 7,250 gallons. Area of the dry cargo portion enclosed with 3-foot-high side and end board is 710 cubic feet. The tandem axle trailer is 10 feet high and weighs 10,715 pounds empty. The enclosure for the dry cargo area, a removable aluminum extruded board 100 inches long and hinged tailgate, can be increased to 5 feet, 6 inches high. Legal limit is 12 feet, 6 inches.

The trailer was designed by Standard Steel Works, Inc., to eliminate empty back hauls. It was made from high strength 5454 and 6061 aluminum alloy sheets and extrusions supplied by Kaiser Aluminum. The components were joined by MIG welding using 5356 welding wire.

Circle No. 51 on Reader Service Card. ——→

LINCOLN WELDERS

three phase rectifier ***IDEALARC R3M®***
DC arc welders

Announcing a new family of ***LINCOLN WELDERS***

. . . full range of sizes, 300 amp to 650 amp
. . . generous capacity in each size
. . . ideal arc characteristics
. . . rugged, maintenance-free, construction
. . . surprisingly low price

IDEALARC
R3M-400
LINCOLN
WELDER

A great new addition to the World's Most Popular Line of Welders

Lincoln's all new IDEALARC R3M

three phase rectifier DC arc welder

With such a large group of Lincoln welders already available to meet the needs of welding users, you might wonder why the new Idealarc R3M is necessary. Here is the reason—on some applications the following are either necessary or highly desirable:

1. DC welding current for small sized electrodes or stainless steel, alloy, non-ferrous or other special electrodes.
2. A current range broad enough to handle both semi-automatic equipment and small manual electrode.
3. A balanced, three phase input current.
4. Quiet operation.
5. Low idle currents.
6. High power factor and efficiency.

Only in a three phase rectifier, such as the new Idealarc R3M, can all these features be incorporated into one machine.

In addition to these features, the rugged construction of this new Lincoln welder promises to set new high standards of trouble-free operation and minimum maintenance. The highly efficient silicon rectifiers do not age or deteriorate and are exceptionally well protected against overloads with special electrical circuitry.

APPLICATIONS

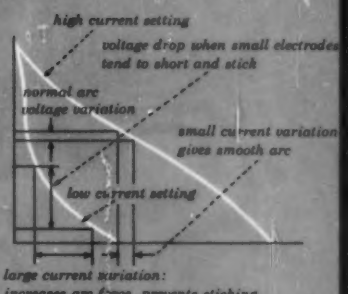
For Manual Welding—The Idealarc R3M will handle *any* manual electrode. Its output characteristics produce smooth, steady, spatter-free welding at high currents and strong current surges that prevent sticking at low currents. In the production plant, maintenance shop, or the construction site, your operators will enjoy using the Idealarc R3M.

For Semi-Automatic Welding—The larger sized Idealarc R3M's, equipped with the optional "Power Pack", can be used as a power source for Lincoln's submerged arc Squirt Welders or other semi-automatic equipment. Equipped with two sets of leads, one Idealarc R3M can be used alternately for both manual and semi-automatic welding—double duty for added versatility and reduced capital investment!

PERFORMANCE FEATURES

Output Characteristics—Idealarc R3M has unique and important built-in characteristics that make welding easier.

First, to prevent sticking with small electrodes, the machine produces a surge of current as arc length is shortened. This surge, seen as the "toe" of the low current settings curve, eliminates the need for separate switches and circuits to prevent sticking.


high current setting
voltage drop when small electrodes tend to short and stick
normal arc voltage variation
small current variation gives smooth arc
low current setting
large current variation: increases arc force, prevents sticking

Second, for smoothest operation of large electrodes, the output curve at high current settings is quite flat and relatively unaffected by arc length variations. There is minimum spatter and "wild arc" action.

Third, for maximum arc stability, R3M's choke coil is designed so that any electrode can be run at any appropriate current, using any technique, with complete freedom from pop-out.

Input Power—The Idealarc R3M draws a balanced three phase current from the lines. Particularly important where machines are installed on existing lines, this characteristic usually permits direct replacement of obsolete welders with new Idealarc R3M's without installation of additional wiring, switches or fuse boxes.

Starting and idle current on Idealarc R3M welders is practically nil, amounting to less than 15% of the rated input current. On field applications, the number of machines which can be powered by one generator set depends only on usable rated current, not starting current.

Power factor is high and idle amps low on the Idealarc R3M. Efficiency is excellent. Overall, for machines operating at rated load, efficiency is about 75%. Note that the silicon rectifiers contribute considerably to this. They are about 4 times as efficient as selenium rectifiers.

You'll find the Idealarc R3M welder truly ideal from the standpoint of every input power consideration.

Low Cost—After you've checked the performance and construction features of the Idealarc R3M and convinced yourself that it is tops in its class, then look at its price. You'll be pleasantly surprised.

LINCOLN WELDERS

IDEALARC R3M

Three Phase Rectifier, DC Arc Welder

CONSTRUCTION DETAILS

Current Control — An easily turned crank on the front of the machine provides continuous current control over the entire range of the machine by a movable core in the reactor windings. The mechanical system used to move the core is rugged, noise-free, smooth and free of creeping problems.

Polarity Switch — Durable, silver-plated contacts with sturdy mechanical construction assure thousands of trouble-free polarity changes.

Case — The recessed front prevents damage to external controls. Output studs are recessed even further and separated to eliminate accidental shorts. Strain relief loops prevent needless wear on output studs and loose connections that dissipate output and cause operator annoyances.

Lift Bail—Whether you move your machine once or hundreds of times, the convenience of the sturdy lift bail will be apparent. Welded directly to the sturdy frame of the machine, the lift bail is attached permanently regardless of how severely it is used.

Signal Light — Red light indicates machine is on; prevents accidental idle operation during non-working hours.

Line Contactor Starter and Overload Protection —Operated by a push button on the front panel, a heavy duty magnetic contactor energizes the machine. Protective circuits automatically disconnect the welder from the line in the event of overload, overheating from any cause, or input power failure. This well-proved protective system makes it virtually impossible to burn out the Idealarc R3M.

Weatherproofing — Louver design prevents entry of rain, or other falling liquids, into the machine. Also, electrical parts receive a double dip in a special insulating material after they are assembled and interconnected to repel the attack of salt air or other corrosive atmospheres.

Silicon Rectifiers — After years of testing, Lincoln engineers are convinced that the silicon diodes and circuitry employed in the Idealarc R3M provide unequalled rectifier performance and life. To the well-established efficiency and freedom from aging of silicon diodes, Lincoln has added exceptionally large safety margins and unique protective circuits to overcome the problem of overvoltage failures that plagued silicon rectifiers in the past. The results are outstanding.

Windings—Most of the windings in the Idealarc R3M are aluminum, which permit a compact, lightweight design. As in other Lincoln welders the aluminum-copper connections are flash-butt welded and sealed forever in a protective coating. There are no mechanical aluminum-copper joints.

Fan and Cooling System—A large fan moves generous quantities of cooling air through the machine. Clean air flows in at the top of the welder, passes first over the rectifier heat sinks, then down over the windings, and exhausts through louvers in the front panel. A large safety factor in temperature rise, designed in the machine, permits the use of the Idealarc R3M on even unusually severe applications.

SPECIFICATIONS

		Idealarc R3M			
Model	60 cycle	K-1149	K-1150	K-1151	K-1152
Type	50 cycle	K-1153	K-1154	K-1155	
NEMA Rating: Current		300 amps	400 amps	500 amps	650 amps
Arc Voltage		40 volts	40 volts	40 volts	40 volts
Duty Cycle		60%	60%	60%	60%
Current Range		30-375	40-500	50-625	65-750
Input Power: Voltages *		208, 220/440, 220/550 volts			208 220/440
Cycles		60 and 50			60
Phase		Three Phase			Three Phase
Rated Current (220 volts)		58 amps	75 amps	94 amps	120
Idle Current		9 amps	11 amps	13 amps	13
Power Factor @ Rated Load		74%	76%	75%	74%
Weights (Approx.): Net		586 lb.	675 lb.	800 lb.	910 lb.
Domestic Shipping		650 lb.	739 lb.	864 lb.	974 lb.
Export Shipping		731 lb.	820 lb.	945 lb.	1055 lb.
Dimensions (all types)		Height	Width	Depth	
Machine, overall		39⅛"	26⅛"	28⅛"	
Export Crate		55"	36"	36"	

*220 380 and other single voltages available on special order

OPTIONAL FEATURES

(at slight additional cost)

Undercarriage—provides portability. A sturdy three-wheeled undercarriage with either steel (K-726) or solid rubber tires (K-726R) is available for field installation.

Remote Current Control — Changes machine current setting from the operator's station with a simple toggle switch. The switch operates a motor inside the welder case which rotates control crank to adjust current up or down. Available factory-installed only.

ML-2 Power Pack—provides 115 volt DC control power and other circuits necessary for Lincoln ML-2 Squirt Welder. Available as a kit for field installation.

115 Volt Starter Circuit—for plants with regulations requiring 115 volts on starter push button circuits. Available factory-installed only.

Accessory Kit—includes headshield and lenses, electrode holder, ground clamp, and cables. Priced below total price of individual components.

Remote Polarity Control — Change from DC (+) to DC (—) or vice versa, with a switch attached to the electrode holder or mounted at the operator's station.

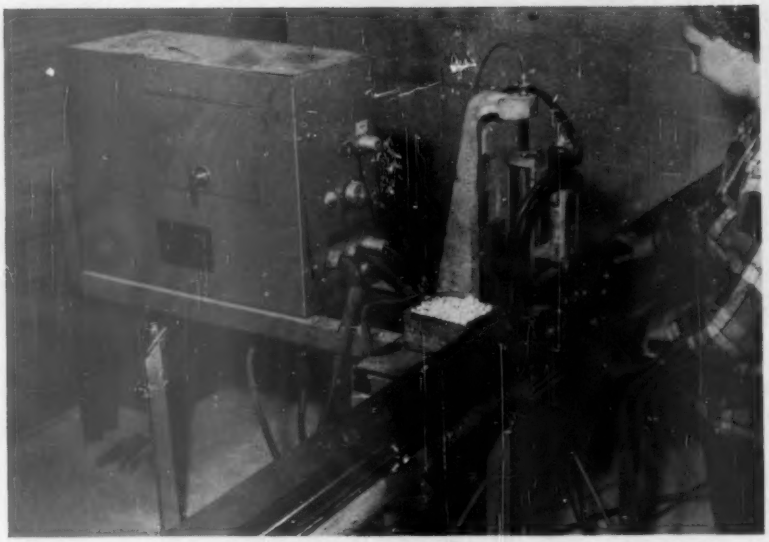
THE LINCOLN ELECTRIC COMPANY
Cleveland 17, Ohio

The World's Largest Manufacturer of Arc Welding Equipment and Electrodes.

LINCOLN ...USA

Mach 3 Skyline

LOS ANGELES, CALIF.; Engineers Bill Clark, left, and Frank Rutkosky of North American Aviation, Inc., appear to be putting together a model city that has a New York-type skyline. It's actually a study board containing brazed honeycomb samples which have been tested to the point of failure on a tensile machine. Strength information provided by samples is being used in engineering development of the 2000-mph B-70 bomber.



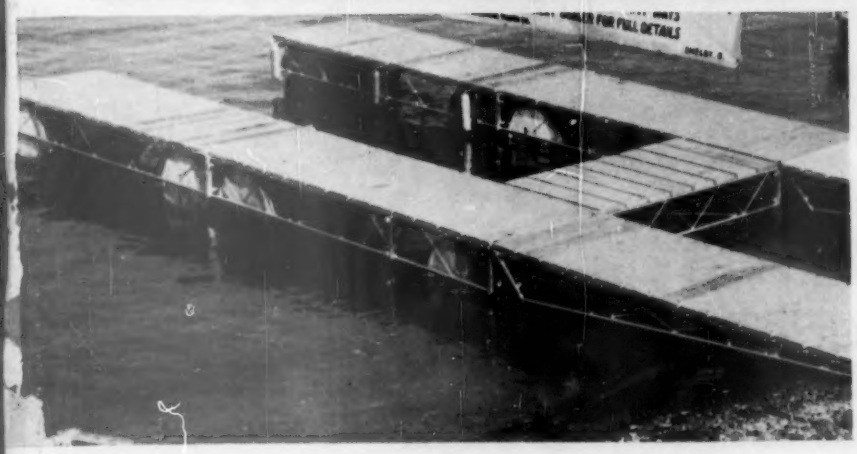
Stud welding keeps dock planks secure

SHELBY, OHIO: Boating, the fastest growing sport in the U.S., is benefitting by the practice of wartime shipbuilders who used stud welding to secure wood decking. The American Tower Company buttons down planking on free-floating boat docks with stud welding.

American uses studs made by Nelson Stud Welding Div., Gregory Industries, Inc., and welds them to the 16-gage side rail tubes of the docks. Then they slip drilled, 1-inch oak planks over the studs, secure them with Nelson T nuts which bite into the wood until flush with it.

Studs attach twice as fast as other fasteners. American tried J-bolts experimentally, but the bolts opened up and were soon lost.

During welding, the 10-foot tube rides on a fixture that stops every four inches beneath the Nelson gun. It takes just seven minutes to weld 28 ¼-inch by ⅞-inch long studs to the tube.



New Safety-Lock Tab·Improved Cup Shape Add Increased Protection and Comfort to AO Flexible Mask Goggles

Here are four improvements that make these new AO Vinylite Mask Goggles safer to use, more comfortable to wear:

1 New lock tab, with snap button, holds adapter securely to frame at point of greatest stress, improves fit around entire frame. Adapter will not pop out, can be removed quickly and easily for cleaning or replacement.

2 New recessed slots at end of cup fit *over and around* temples of safety (or regular) glasses to keep entire cup edges in contact with face.

3 Increased eye cup depth gives additional coverage and protection at temples.

4 Improved flash around entire edge of mask molds to contours of face, permits no stray light to enter.

These new goggles have a nylon adapter to hold lenses securely in frame without buckling or cracking from heat. Four indirect ventilating louvers on each cup provide good ventilation and fog control. Lightweight mask fits closely but comfortably over all safety glasses.

Your nearest AO Safety Products Representative can also show you the companion grinding and chipping goggles, with clear frame, clear transparent adapter and Super Armorplate lenses. Contact him for complete details, or write for illustrated folder S-1229.

Your Surest Protection . . . AO SURE-GUARD GOGGLES

American Optical
COMPANY

SAFETY PRODUCTS DIVISION • SOUTHBRIDGE, MASSACHUSETTS

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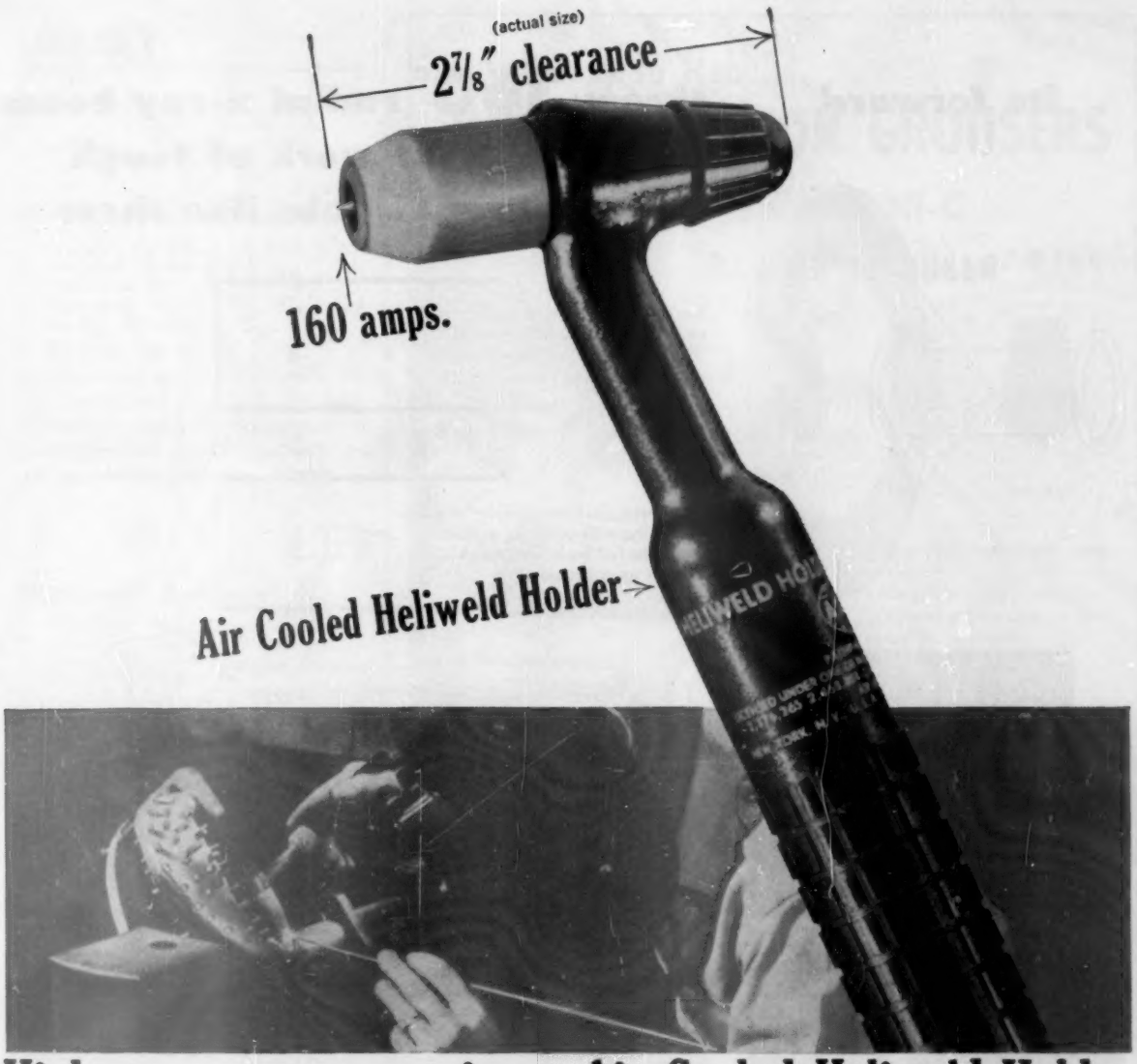

Highest amperage yet in an Air Cooled Heliweld Holder

New Airco H16-A. Only 2⅞" interference dimension and no water system! The new Airco H16-A Heliweld Holder, for tungsten-inert-gas welding, is the only air cooled torch available with 160 amps AC or DC – and it's the easiest to handle. Here's the torch for work in tight spots!

The Airco H16-A is a gem for jobs requiring rapid, clean, smooth welds on thinner gauge aluminum, alloy and stainless steels, brass, cast iron, copper, magnesium, molybdenum, nickel, silver, and many others.

Airco produces everything you require for manual and automatic Heliwelding. The line includes the H10 air cooled, H20 water cooled, H35 water cooled, and H50 water cooled Heliweld Holders, and automatic machine heads.

Look in your Classified Telephone Directory, under "Welding Equipment and Supplies," for your nearest Authorized Airco Distributor. Or phone your local district office.

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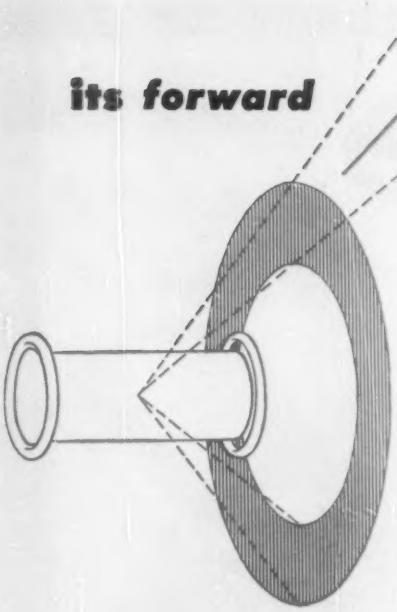
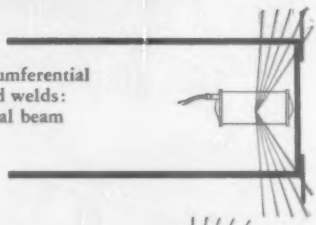
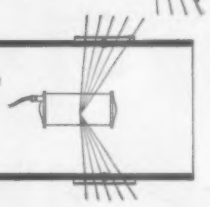
its *forward throw* 360° radial x-ray beam makes light work of tough radiographic jobs like these



Inside-out one shot circumferential radiography of tank-head welds: the forward-thrown radial beam gets the whole corner.



Circumferential radiography of girth welds: the wide-band 30° projection x-rays the full seam with width to spare on either side.



Easy setup for simultaneous panoramic radiography.

Despite the power it packs, the tubehead is light enough for one man to handle.

find all this in the

Easy to position anywhere . . . here it is being lowered for "one-shot" radiography of a massive girth weld.

ANDREX FT360

160 KV portable x-ray unit

lightweight
one man can easily carry its 72 lb. tubehead

compact
can enter a 9" diameter opening

powerful
full 160 KV takes 2" steel, 5" aluminum in stride

selfcontained
complete weatherproof "package"— no shockproof cables or water lines

economical
an investment that will pay manifold dividends for years for a modest outlay

Call any Picker branch office (see local 'phone book) or write Picker X-Ray Corporation, 25 South Broadway, White Plains, N. Y.

Picker x-ray

one stop for everything in industrial radiography

ANDREX	portable x-ray units—130 KV, 160 KV, 200 KV, 260 KV
PICKER	x-ray units—5 to 50 KV, 150 KV (stationary and mobile), 270 KV portable, 260 KV heavy-duty
TECH/OPS	units for isotope radiography—sources, equipment, containers for Iridium 192 Cobalt 60 and Thulium 170
ACCESSORIES	. . . films, tanks, darkroom sundries, illuminators, *everything*

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LIBRARY

of welding

Welding Rocket Cases

"Welded Fabrication of Steel Solid-Propellant Rocket-Motor Cases," May, 1960, Order PB 161206 from OTS, U.S. Department of Commerce, Washington 25, D.C., 29 pages, $0.50.

Welding techniques, selection of welding materials, joint design, working conditions, and inspection procedures for successful fabrication of solid-propellant rocket motor cases are included in this study.

Weldment Restraint

"Problems With Restraint in Heavy Weldment," by Glenn E. Faulkner, assistant chief, Metals Joining Division, Batelle Memorial Institute, Order PB-161204 from OTS, U. S. Department of Commerce, Washington 25, D. C., 10 pages, $0.50.

This report is the text of talk given at the Titanium Alloy Sheet Rolling Panel Meeting in San Diego early last year. Discussed are the current research efforts in the evaluation of welded joints in thick titanium-alloy plates as part of the Navy's study to consider thick titanium plate in deep-diving submarines.

Problems due to restraint are described, as well as methods for studying restraint and methods used to reduce restrain problems. The report contains drawings of two restraint specimens.

Welding in Russia

Moravskiy, V. E. Kondensatornaya svarka metallov malykh tolshchin (Stored-energy light-gage welding). Moskva-Kiyev, Mashgiz, 1960, 143 pages.

This book describes Soviet stored-energy spot and seam welds and discusses conditions for welding light-gage metals and alloys. It summarizes research done at the Institute of Electrical Engineering, Academy of Sciences, UkrSSR, the Kiyev Polytechnic Institute, the Moscow Higher Technical School, and at several industrial plants. The material used includes the theses work of the author.

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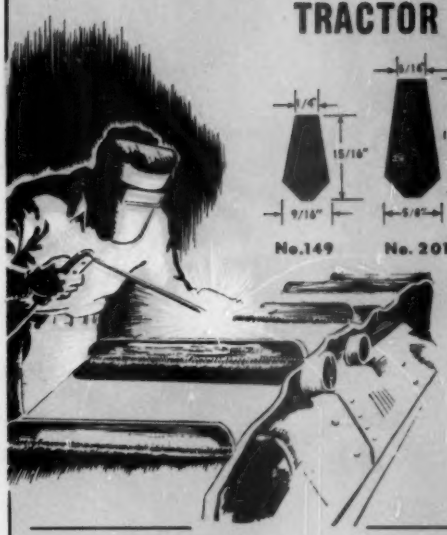
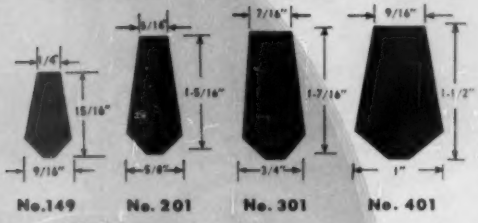
HIGH CARBON STEEL

TRACTOR GROUSER BARS





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11%-13½% MANGANESE-NICKEL STEEL

TRACTOR GROUSER BARS

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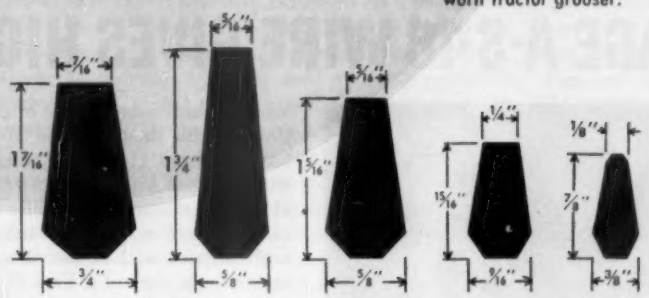
- Size available to fit every worn tractor grouser.



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- BULLDOZER BLADE EDGES — rebuild with Manganal Round or Special Shape Applicator Bars.
- BULLDOZER MOLD-BOARD — flame cut from Manganal Hot Rolled Plate.

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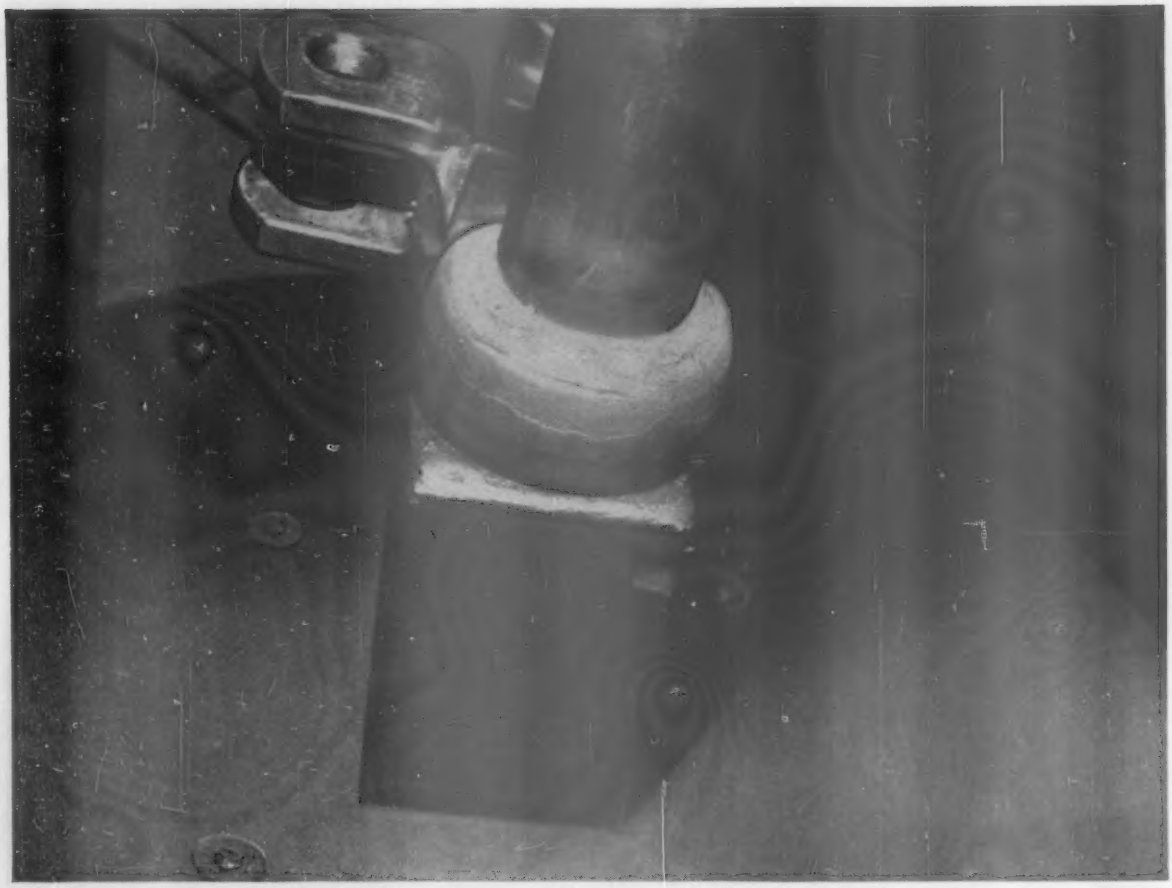

at International Harvester's East Moline Works

PAGE A-S-18 WIRE GIVES HIGH TENSILE WELDS

The 500# Payoffpak in the background furnishes a steady flow of uniform PAGE A-S-18 wire for uninterrupted production of consistent high quality

Welding is the backbone of production at the East Moline Works of International Harvester, and PAGE welding wire Analysis A-S-18 is used at the Works on parts made of high carbon steel which are subject to high impact and stress. Above, for example, is part of a Fast Hitch for hooking farm implements to Farmall tractors. The steel is SAE 1050, and A-S-18 wire gives a clean, non-porous, high tensile weld that stands up under the most rugged service.

A-S-18 is also used on combine shafts and cross-members—equipment which requires high tensile strength. Purchased in coils and Payoffpaks, PAGE A-S-18 enables East Moline Works to substitute semi-automatic welding on many jobs previously done with stick electrodes.

• • •

Let PAGE help solve your welding problems • From 33 analyses, PAGE can furnish the *right* wire, in every form of modern packaging, with prompt delivery from a coast-to-coast network of PAGE distributors and warehouses. Bring your welding problems to PAGE —we'll be glad to help you improve your quality and lower your production costs.

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PAGE—*THE SOURCE FOR ANSWERS TO WELDING PROBLEMS*

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JANUARY, 1961
Welding Design & Fabrication
ESTABLISHED IN 1930 AS INDUSTRY & WELDING

A SPECIAL REPORT

Do Welding Users Want Price Or Performance In 1961?

IN BRIEF: A cross-section of American Industry told us the factors that influenced their choice of welding equipment in the past two years would also influence their 1961 buying.

THE RIVALRY between performance and price is summed up by Bill Hornung, welding engineer, at Whirlpool Corporation's Marion, Ohio, Division. He told WELDING DESIGN & FABRICATION: "We watch the price and the performance of our welding equipment because we want the laundry equipment we make to be competitive in price and quality."

But which, price or quality, is really the more important to the majority of welding users?

The answer to this question is one of the most important facts to come out of an industry-wide survey made by WELDING DESIGN & FABRICATION. By mail and by personal interview, we asked Mr. Hornung and 500 other readers, who represent a cross-section of American industry, what welding, cutting, and fabricating equipment they bought recently (see list on page 33). We asked on what basis they had made their choices. And, while we were at it, we asked them some other important questions on their buying habits.

We analyzed the results. Here's what we found:

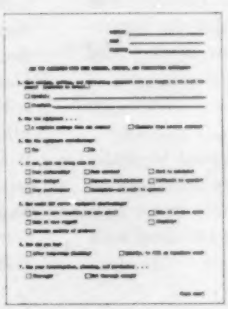
IT'S PERFORMANCE OVER PRICE!

First, we asked about the relative importance of seven factors that influence purchasing. These are performance, manufacturer's reputation, design, maintenance, price, delivery, and portability. Our readers rated these, labeling the most important first and on down to the least important, which they marked seventh. Here are the results:

Performance: This is what the product does and what it saves in manufacturing costs. It was far and away the most important influence in equipment buying. It received more than half of the first place votes, 20 percent of the second place choices, and was never rated lower than third. According to a weighted score (see table on page 32), it far outdistanced the second most important buying influence which was:

continued on page 32

this questionnaire went to 500 readers



and brought this information . . . .

This is how the buying influences were rated when this typical

BUYING INFLUENCE	HOW RANKED							WEIGHTED SCORE
	FIRST	SECOND	THIRD	FOURTH	FIFTH	SIXTH	SEVENTH	
PERFORMANCE	1st	2nd						100%
REPUTATION	2nd		1st			1st		72%
DESIGN	3rd	3rd		2nd	3rd		3rd	60%
MAINTENANCE		1st	2nd	3rd				54%
PRICE			3rd	1st	2nd		2nd	53%
DELIVERY					1st	2nd		29%
PORTABILITY						3rd	1st	15%

PERFORMANCE is the most important buying influence so we rated it at 100 percent and compared the other buying factors with it on a percentage basis. The chart also shows which of the seven buying influences received the most first, second, and third place votes in each of the seven degrees of importance that could be attributed to each.

Reputation: This buying influence received 25 percent of the first place votes and a goodly number of second and third place choices. It shows that American industry takes the welding equipment manufacturers word that their product will do an economical and efficient job. Whether or not this is done is based on the equipment's:

Design: This was rated third. It received 16 percent of the first place votes, 16 percent of the second place votes, and many fourth and fifth place choices.

Price and maintenance: These two factors ran almost neck and neck. Their weighted scores varied only slightly, and they received an almost identical number of second, third, and fourth place choices.

Delivery and portability followed in that order and seemed to be relatively unimportant as purchasing influences. Many did not bother to rate them at all. Of course, delivery is not a factor in today's market. But, it can be when shortages occur as they did during the Korean war.

WAS THE EQUIPMENT SATISFACTORY?

We asked this question because it followed logically and would reveal whether welding users who replied got those features they considered most important. Our survey showed that 87 percent were satisfied with their equipment; 13 percent were not.

Of those 87 percent who were satisfied, 42 percent said their equipment had met expectations in both performance and savings. The remainder said their equipment had met expectations in performance or savings, but not both.

To those 13 percent who were dissatisfied, we pointed this question:

WHY WAS THE EQUIPMENT UNSATISFACTORY?

We asked them to look over a list of eight things with which they might have been dissatisfied. These were poor workmanship, poor design, poor performance, poor service, expensive installation, difficulty in maintenance, operational difficulties, and equipment that was incomplete and not ready to use.

We found there were three levels of dissatisfaction:

First: Poor design, maintenance difficulties, and incomplete equipment were in pretty much of a 3-way tie. Each received about 20 percent of the total vote. One reader, who wants to be anonymous, was unhappy with a 100 KVA spot welder. He said it was too complicated for easy servicing; he felt its complex electronic circuitry should be simplified. Another anonymous reader took a shot at manufacturers for failing to give adequate, concise, pertinent data that identifies components and simplifies maintenance.

Second: Poor performance and operational dif-

equipment was purchased . . .

AC welders
AC/DC welders for tungsten inert gas shielded welding and for mechanized inert gas shielded welding
Automated arc and resistance welding lines
Automatic welding heads
DC welders
Electrode holders
Flame cutting machines
Metallizing equipment
Press brakes
Press-type welders
Semi-automatic welding equipment, including guns and accessories
Spacing tables
Spot welders
Stud welders
Submerged arc welding equipment
Torches and regulators
Tungsten arc cutting equipment
Turning rolls
Welding manipulators

ficulties were at the next level, each getting about 12 percent. One big difficulty seemed to be that many wires for automatic and semi-automatic welding jammed in drive rolls. Several readers complained about this. They added that they did get excellent cooperation from suppliers in replacing defective wire.

Third: Poor workmanship and expensive installation followed, each getting about 7 percent.

No one complained about service. Indeed, most praised it highly. Here's the reaction of John A. Henry, plant superintendent, at Spotweld Division of Otto Konigslow Mfg. Co. after purchasing a spot welder and an AC/DC welder: "The technical men showed genuine interest in any and all problems, made maintenance suggestions on how to save money, and evaluated for possible design changes in future models the corrective steps our own maintenance people had taken."

We wanted to know what those dissatisfied people would do to cure shortcomings. We asked:

HOW WOULD YOU CORRECT EQUIPMENT SHORTCOMINGS?

We presented five choices. Our readers could ask for equipment that would be more versatile, more rugged, or more productive. Or, they could ask for simpler equipment that would turn out a better end product. Here's a breakdown of the replies:

31 percent said simplify the equipment
23 percent said make it more rugged
21 percent said make it more versatile
17 percent wanted a better end product
8 percent said increase productivity

But, all of these people were not genuinely unhappy with their suppliers. We found that out when we asked them:

WOULD YOU BUY FROM THE SAME COMPANY AGAIN?

The answer was a resounding: *YES!* More than 90 percent said they would. Five percent said no, and five percent said they were not sure. Several people said they would buy again from the same supplier only if quality, design, and performance were brought up equal to that of other equipment on the market.

And, while we were posing questions, we asked these:

HOW AND WHY DID YOU BUY?

About 70 percent of the people who replied said they bought equipment after long, thorough planning. The remainder bought quickly to meet a pressing need.

WAS THE EQUIPMENT A COMPLETE PACKAGE?

About 75 percent of those replying said they bought their equipment as a complete package from a single source. One who did was Frank Flocke, Thorton Company, who bought an AC/DC welder package for tungsten arc and semi-automatic welding. He ordered it on a ready-to-install basis and has had no trouble.

DID YOU HAVE TO BUY FOREIGN EQUIPMENT?

The answer was a reassuring: *NO!* Ninety-two percent of those who replied said they had not. Those who did bought highly specialized equipment not made in this country.

William Clark, president of C & D Steel Fabricators, summed up the attitude of American industry toward foreign welding equipment and toward our own American equipment when he said: "Top equipment from a reputable American company is a hard combination to beat." • •

A DESIGNER'S GUIDE TO WELDING

EDITOR'S NOTE: The cost-price squeeze and competition are forcing industry to exploit every advantage it can muster. This series, which will run regularly this year, is intended to show designers and others just how to utilize all the potential economies and advantages of arc welded steel to reduce manufacturing costs. Part I that follows says . . .

Weld Metal Has Excellent Properties! Are You Using Them?

IN BRIEF: Weld metal is stronger than the metal it joins and a welded joint is stronger than any other used for joining metals.

TENSILE STRENGTH and toughness are the two factors most important in predicting satisfactory performance for a welded joint. Remember that:

1. The yield and tensile strength of the weld metal should be higher than that of the parent metal.
2. The lowest normal operating temperature of the weldment should be above the transition temperature of the weld and the parent metal.

Elongation of the ductility of the weld metal is of minor importance if these two requirements are met.

TENSILE STRENGTH

It is sound policy to use weld metal which has a higher tensile and yield strength than the parent metal. Structures are normally designed to operate well below the yield strength. However, shock or unexpected loads often occur. If such a shock is thrown on a structure in which the welds have a higher yield strength than the parent metal, any yielding will take place in the parent metal and not in the weld. If the yield strength of the weld is lower than that of the parent metal, the yield will take place in the weld.

Since the mass of the parent metal is normally much greater than that of the weld, failure is much less likely to occur if the yield takes place in the large mass which is the parent metal.

Weld metal with a tensile strength greater than the

COMPARISON OF MECHANICAL PROPERTIES AND COSTS

PROPERTIES	ASTM - ASME CLASSIFICATION		WELD METAL DEPOSITED WITH E-60XX ELECTRODE
	A-7 (Mild Steel)	A-242 *	
TENSILE STRENGTH (PSI)	60-72,000	65-75,000	62-90,000
YIELD POINT (PSI)	33,000	50-65,000	52-86,000
ELONGATION IN 2 IN.	28%	20-22%	17-25%
COST PER POUND	$ .053	$ .07625	
PER CENT PREMIUM		44%	

*Properties of commercial steels such as Manten, Corten, Triten, etc.

MANY DESIGNERS are unaware of the premium mechanical properties of the metal deposited by arc welding. Overdesigning and impractical weld standards frequently occur because of this lack of knowledge. Today, industrial designers will pay a premium price to use the better properties (higher tensile and yield strength) of low alloy steel to meet severe service requirements. Their new designs use these improved mechanical properties to reduce weight or increase strength and load capacity. This chart shows that weld metal provides mechanical properties which meet or exceed the properties of some premium priced steels.

plate often brings forth the question, "Isn't a weld of much higher strength than the plate likely to produce failure in the fusion zone?" The answer is an emphatic *NO!*

Except for such things as bombs, all weldments are designed to operate well below their yield strength. All steels when operated below their yield strength perform exactly alike. For example, a piece of mild steel and high strength alloy steel of the same dimensions perform exactly the same below the yield strength. Therefore, if two pieces of mild steel are joined by a high strength alloy steel weld, the joint performance, below the yield point, would be exactly the same as if the two pieces had been joined by a mild steel weld.

DUCTILITY

Ductility is important if the material requires forming. For example, very ductile sheet metal is required in making deep drawn parts. Spring steel would be unsatisfactory because of its low ductility. However, spring steel with its low ductility is entirely satisfactory for the service requirements of a spring.

There is no evidence to show that service requirements need more than a few per cent elongation as measured by the ductility test. Welded joints and steel plates with high elongation figures sometimes fail during service or during welding and do so without appreciable elongation.

Because ductility can be expressed in figures, there is a tendency to be impressed by them, to be favorably disposed toward getting them as high as possible, and to draw specifications upon these arbitrary figures. Once having drawn such specifications we tend to think in terms of those figures rather than in terms of the plastic action concerned. Because very definite figures of tensile strength and elongation can be obtained, such tests are good. However, such figures mean little as far as predicting how well that weld metal will perform in a welded joint.

Like vitamins to a human body, a certain minimum ductility is needed in a weldment. Additional ductility, like additional vitamins do no good if the minimum requirement is met. Likewise, an additional amount does no harm provided something else is not sacrificed. As an example, E-6012 electrodes, which have less ductility than the E-6027, perform more satisfactorily on many applications.

Other examples which have no connection with welding indicate that the arbitrarily high values placed on ductility requirements are much higher than necessary in most cases. As examples of adequate ductility, wires for bridge cable have less than 7 per cent elongation. Steel for big gun barrels, which stand tremendous shock loading have as low as 5 per cent elongation.

Millions of cast crankshafts used by automobiles in the United States have less than 1 percent elongation.

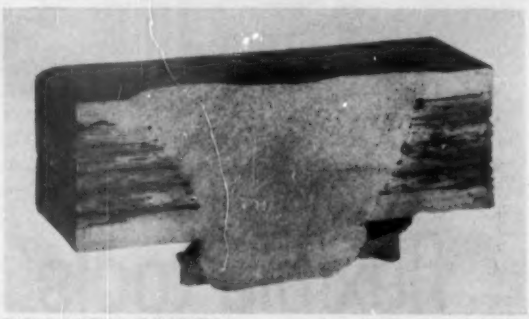
Without further examples it should be obvious that ductility of test specimen is no sure criterion of performance in actual service. It is often true that we ask for and measure elongation when what we really desire is toughness. Toughness is broader than ductilty. Lead is very ductile but it is not called tough. Toughness is the ability to absorb energy rather than the ability to deform.

TOUGHNESS

Toughness is difficult to define; it is affected by tensile strength, ductility combined with such factors as rate of application of load, temperature, notches, smoothness, and others.

One of the properties of toughness can be measured quantitatively by impact. An impact load is a shock load. Many structures or joints which fail, fail as a result of a shock load. The amount of shock loading which a structure or joint will withstand varies widely with temperature. For example, some pieces of steel can be hammered with no noticeable affect on a summer day. Yet, if struck the same blow on a winter morning, the same piece may snap like a piece of glass.

If two tensile specimens had been made out of this same material and tested at the same temperature as the hammered pieces, in a tensile testing machine, little if any difference would be detected in the tensile strength and elongation of the two specimens. Therefore, toughness at the temperatures which will be encountered in service is important. The actual value of impact is not important. The important point in this case is the transition temperature. The transition temperature is that temperature above which the test specimen will absorb energy before failure and below which will fail in a brittle manner with little absorption of energy.



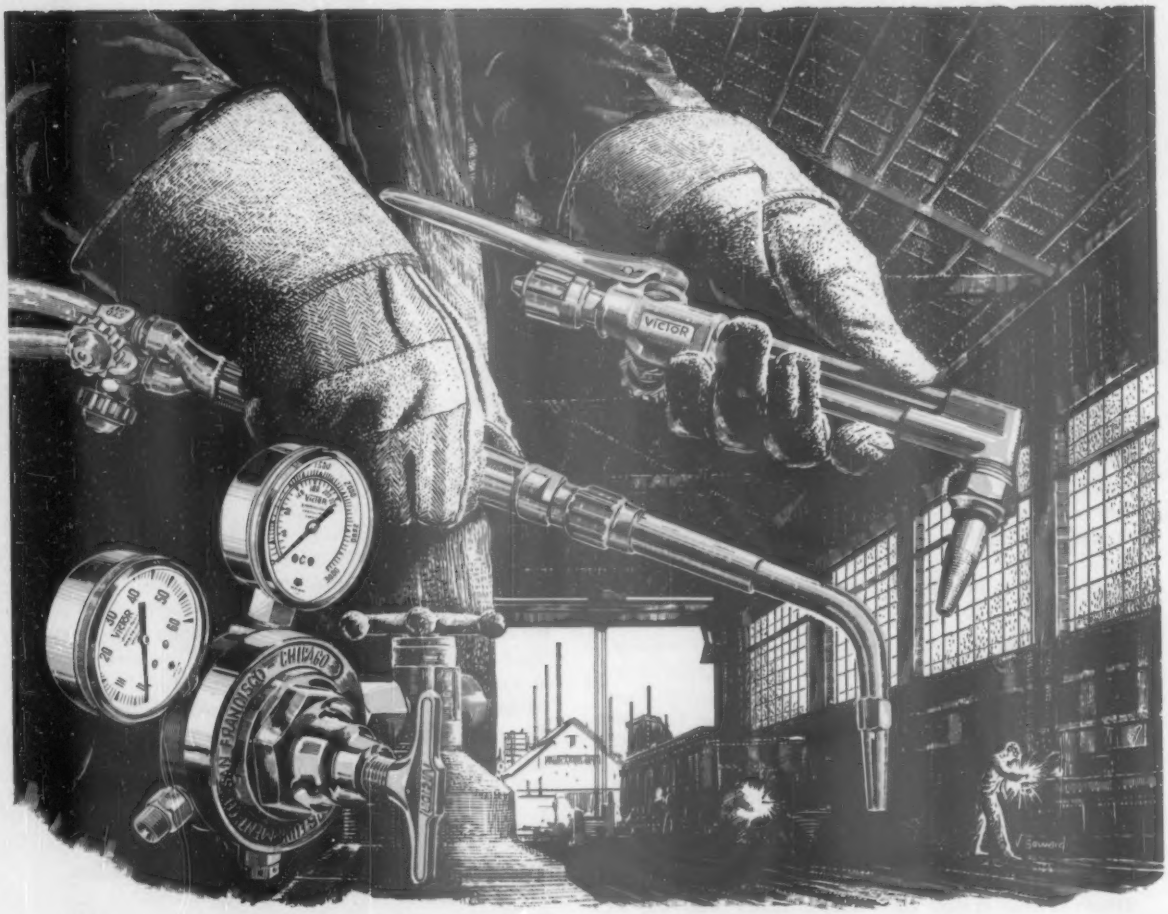
WELD METAL QUALITY is compared to base material in this etched specimen. Subjecting this sample, a sectioned plug weld in mild steel, to an acid etch demonstrates that weld metal has a more uniform homogeneous structure.

Properly designed weldments normally will not fail due to shock loading if the transition temperature of parent metal and weld is lower than the operating temperature of the structure. Severe shock loading may produce failure if the weldment temperature is lower than the transition temperature.

Obviously, electrodes with low transition temperature are desirable.

Electrode types in order of desirable transition temperatures are as follows: low hydrogen (best-lowest transition temperature); E-6024, E-6027, and E-7024; E-6010 and E-6011; E-6013; and E-6012 (highest transition temperature).

EDITOR'S NOTE: "Are You Buying Too Much Weld Metal?" is the provocative title of the next article in this series. It will appear in our March issue and will discuss weld size and the ever-present problem of overwelding.



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SEALING
G.18B, G.34
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REFRACTALOY
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NIMONIC 90
M-252
UDIMET
INCONEL 700
WASPALOY
HS-21, -25, -31
S-816
COBENIUM
ELGILOY
RODAR
THERLO
KOVAR A

How To Weld The Cobalt Alloys

by W. J. LEPKOWSKI and R. E. MONROE, *Battelle Memorial Institute, Columbus, Ohio,*

IN BRIEF: The heat- and corrosion-resisting cobalt-base alloys weld like the austenitic stainless steels—with local differences. Here are guides to good welds in these alloys.

COBALT ALLOYS, of the iron-, nickel-, or cobalt-base types, go into many weldments. You weld them with the same processes and techniques you use to weld the austenitic stainless steels, but with local differences. The cobalt alloys resist corrosion and heat like some of the stainless steels.

If you want strong, sound welds in cobalt alloy weldments, have your metal clean. Remove tight oxide (from heat treat) with molten caustic and acid solutions. Get rid of oil, grease, and crayon before welding or heat treatment. These contaminants may make the metal brittle.

Prevent stress concentrations in cobalt weldments with good joint design. If the metal is thicker than ¼ inch, use a U-joint; thinner, use a V-joint. Beveling isn't necessary on 12-gage, and thinner, metal. When you weld unequal thicknesses, bevel the thicker piece. Use more joint clearance for cobalt alloys than you would for steel.

Use caution in clamping the cobalt alloys for welding. You can clamp some of them rigidly. Others will crack if restrained too much. Where possible, use grooved backup bars to get full penetration and good bead contour and to keep the weld cool. When you inert arc weld the cobalt alloys, use pure argon, and keep the flow rate high.

Direct current, reverse polarity works the best when you arcweld or submerged-arcweld the cobalt alloys. Inert arc weld them on straight polarity, using the smallest tungsten electrode possible without contaminating the weld. Prevent crater cracks in arc welding by using starting tabs. Don't weld with high heat.

Clean, smooth material is the key to good resistance welds in the cobalt alloys.

IRON-BASE ALLOYS

These alloys (see table, page 38, for compositions) are for heat resistance and for metal-to-glass seals.

Sealing Alloys can be soldered, brazed, and welded. Arc weld them with flux-coated electrodes of either 18-8 or 25-12 austenitic stainless steel. To weld Rodar, Therlo, and Kovar A to soft steel use metal inert-gas or tungsten inert-gas welding.

G.18B. Use coated G.18B electrodes for arc welding this alloy. Use G.18B wire as the filler metal when you inert arc weld it. It can be resistance welded. Stress relieve after welding. Don't preheat this alloy.

N-155 is the most-used iron-base cobalt alloy. Solution-treated, the alloy has an austenitic matrix with scattered spherical carbides. The dendritic weld contains a eutectic. It melts at low temperatures and may cause hot cracks. It's best to keep the welding heat low and the restraint light to avoid cracks.

Welding currents, speeds, and gas flows for tungsten arc welding (see Table 1, page 39) are for flat-butt, square-edge joints. The torch was mounted on a rail; the weld was backed with a grooved copper bar. The groove was 1/16-inch deep by ½ inch wide.

Weld Alloy N-155 to itself with N-155 electrodes. Weld it to other superalloys with Hastelloy W or Inco-Weld A electrodes. Use AMS Type B (lime-titania) coated electrodes. If the weld cracks, use Type A (lime) coated electrodes. Weld N-155 with these currents:

	Current in amps for various electrode diameters			
Kind of joint	3/64	1/16	5/64	3/32
Butt, Overlay, Lap	15-25	24-40	35-55	45-70
Fillet	20-30	30-45	40-60	50-80

You can resistance weld N-155 with slightly modified stainless steel settings. Its heat transfer is a little less than Type 304 stainless steel.

NICKEL-BASE ALLOYS

The nickel-base alloys age harden (see table, page 38, for compositions). This means they aren't ductile when heated through the aging temperatures, and they

continued on page 39

COMPOSITION OF THE COBALT ALLOY GROUPS

Iron-Base Alloys

Alloy Designation	Nominal Composition, weight per cent									
	C	Si	Mn	Cr	Ni	Co	Fe	Mo	W	Others
G.18B	0.32 - 0.48	0.7 - 1.7	0.5 - 1.0	12.0 - 14.0	12.0 - 14.0	9.0 - 11.5	Bal.	1.4 - 2.2	1.8 - 3.3	2.4 - 3.6 Cb
Multimet (N-155)	0.2 max. (*cast*) 0.08 - 0.16 (*wrought*)	1.0 max.	1.0 - 2.0	20.0 - 22.5	19.0 - 21.0	18.5 - 21.0	Bal.	2.5 - 3.5 (*wrought*)	2.0 - 3.0	0.75 - 1.25 Cb+ Ta; 0.1 - 0.2 N_2
S-590	0.38 - 0.47	0.3 - 0.8	1.0 - 2.0	19.0 - 21.0	19.0 - 21.0	19.0 - 21.0	Bal.	3.5 - 4.5	3.5 - 4.5	3.5 - 4.5 Cb
Kovar "A"	0.06 max.	0.2 max.	0.05 max.		28.7 - 29.2	17.3 - 17.8	Bal.			
Rodar	0.06 max.	0.2 max.	0.05 max.		28.7 - 29.2	17.3 - 17.8	Bal.			
Therlo			0.3 max.		28.5 - 29.5	16.5 - 17.5	Bal.			

Nickel-Base Alloys

Alloy Designation	Nominal Composition, weight per cent										
	C	Si	Mn	Cr	Ni	Co	Fe	Mo	Al	Ti	Others
Refractaloy 26	0.08 max.	0.5 - 1.5	0.4 - 1.0	16.0 - 20.0	35.0 - 39.0	18.0 - 22.0	Bal.	2.5 - 3.5	0.25 max.	2.3 - 2.9	
Rene 41 (J-1610)	0.09			19.0	Bal.	11.0	0.2 max.	10.0	1.5	3.0	
Nimonic 90	0.10 max.	1.5 max.	1.0 max.	18.0 21.0	Bal.	15.0 - 21.0	5.0 max.		0.8 - 1.8	1.8 - 2.7	
M-252 (J-1500)	0.10 - 0.20	0.3 - 1.0	0.5 - 1.5	18.0 - 20.0	Bal.	9.0 - 11.0	5.0 max.	9.0 - 11.0	0.5 - 1.25	2.25 - 2.75	
Udimet 600	0.10 max.			15.0 - 20.0	Bal.	13.0 - 20.0	4.0 max.	3.0 - 5.0	3.8 - 4.6	2.50 - 3.25	0.04 max. B
Udimet 500	0.15 max.	0.75 max.	0.75 max.	15.0 - 20.0	Bal.	13.0 20.0	4.0 max.	3.0 - 5.0	2.50 - 3.25	2.50 - 3.25	0.015 max. S, 0.008 max. B
Inconel 700	0.16 max.			13.0 - 17.0	Bal.	24.0 - 34.0	4.0 max.	1.0 - 4.5	2.5 - 3.5	1.75 - 2.75	
Waspaloy	0.10 max.	0.75 max.	0.5 max.	18.0 - 21.0	Bal.	12.0 - 15.0	2.0 max.	3.5 - 5.0	1.0 - 1.5	2.75 - 3.25	0.03 max. S, 0.1 max. Cu, 0.02 - 0.15 Zr 0.001 - 0.01 B

Cobalt-Base Alloys

Alloy Designation	Nominal Composition, weight per cent											
	C	Si	Mn	Cr	Ni	Co	Fe	Mo	W	Al	Ti	Others
HS-21	0.20 - 0.35	1.0 max.	1.0 max.	25.0 - 30.0	1.5 - 3.5	Bal.	2.0 max.	4.5 - 6.5	—	—	—	0.007 max. B
HS-25 (L-605)	0.05 - 0.15	1.0 max.	1.0 - 2.0	19.0 - 21.0	9.0 - 11.0	46.0 - 53.0	3.0 max.	—	14.0 - 16.0	—	—	—
HS-31	0.45 - 0.55	—	—	24.5 - 26.5	9.5 - 11.5	Bal.	2.0 max.	—	7.0 - 8.0	—	—	—
G.34	1.0 max.	0.4 - 0.6	0.8	18.5 - 19.5	12.0 - 13.0	45.0 - 46.0	Bal.	2.0	—	—	—	2.8 V, 1.2 Cb
Refractaloy 70	0.08 max.	0.4 - 1.0	1.75 - 2.25	19.0 - 21.0	19.0 - 21.0	28.5 - 31.5	Bal.	7.5 - 8.5	3.5 - 4.5 -	0.25 max.	—	—
Refractaloy 80	0.20 max.	0.4 - 1.0	0.5 - 2.0	19.0 - 21.0	19.0 - 21.0	28.5 - 31.5	16.0 max.	9.0 - 11.0	4.5- 5.5	—		—
S-816	0.32 - 0.42	0.9 max.	1.8 max.	19.0 - 21.0	19.0 - 21.0	40.0 - 44.0	5.0 max.	3.5 - 4.5	3.5 - 5.0	—	—	3.0 - 4.5 Cb
J-1570	0.20	—	—	20.0	28.0	Bal.	2.0	—	7.0	—	4.0	—
Cobenium	0.15	—	2.0	20.0	15.0	40.0	Bal.	7.0	—	—	—	0.04
Elgiloy	0.15	—	2.0	20.0	15.0	Bal.	16.0	7.0	—	—	—	0.04

may crack if too-rigidly clamped. After welding, relax stresses by solution annealing.

Look for a lot of expansion when you weld the nickel-base alloys. Resistance weld it with longer weld times and lower currents than you would for steel.

Refractaloy 26: Weld this alloy as you would stainless steel. If possible, solution anneal afterwards.

Rene 41: Fusion-weld or resistance-weld annealed Rene 41, but don't preheat it. Keep welding heat low. Afterwards, it's a good idea to solution anneal, but heat and cool the metal rapidly through the aging range (1,200F to 1,600F).

Weld Rene 41 to itself and to other high-temperature alloys with Hastelloy W. Use the settings listed for Nimonic 90 as a guide.

Nimonic 90: Weld this alloy (see table 2, this page) by either inert arc or oxyacetylene processes using Nimonic 90 filler wire. Use a boron-free flux in oxyacetylene welding. Don't clamp this alloy too rigidly.

M-252: Fusion weld M-252 the same way you do stainless steel. Resistance weld it with less current than you use for carbon steel.

Udimet Alloys 600 and 700, Inconel 700, and Waspaloy: Weld these alloys like you would Nimonic 90 (see table 2). If you are working with Waspaloy, use annealed material, keep welding heat low, and don't restrain the parts too much.

COBALT-BASE ALLOYS

These alloys (see table, page 38 for compositions) weld like the nickel-base alloys. Use little restraint and heat in welding them. The use of jigs and fixtures and good joint design is important. When you resistance weld these alloys use longer weld times and lower currents than with carbon steel.

HS-21: Best welded by the inert arc process.

HS-25: Can be welded by most processes. When you arc weld it (see table 3, this page) use direct current, reverse polarity, and if you can, a copper backup with a rounded groove (3/16-inch wide, 3/32-inch deep). Prevent crater cracks with end tabs. The metal can be welded with tungsten arc and metal inert-gas welding (see table 4, this page) processes. Of the two, metal inert-gas welding heats the work the most.

HS-31 and G.34: The high carbon contents of these alloys make them difficult to weld.

Refractaloy 70 and 80: Weld these alloys the way you would stainless steel. They age harden, so don't restrain them too much when you weld. You can use the data for N-155 alloy for welding Refractory 70 and 80 alloys (see table 1).

S-816 alloy: Can be welded with most processes but requires extra care because of its high carbon content.

Cobenium, Elgiloy: Can be joined by most welding processes. • •

WELDING GUIDES FOR COBALT

1/ N-155: Inert Arc

Material Thickness, in.	Current, amp	Arc Voltage, volts	Weld Speed, ipm	Flow Rate of Argon, cfh
0.032	40-52	9-10	12-17	10
0.050	70-90	9-10	12-17	10
0.063	80-95	9-11	11-15	10
0.094	110-128	10-12	8.5-11	11

2/ Nimonic: Inert Arc

Material Thickness, in.	Type of Joint	Electrode Diameter in.	Filler-Wire Diameter, in.	Current, amp	Weld Speed, ipm	Wire Feed Rate, in./ft	Flow Rate of Argon, l/min
0.036	Square butt, close or 0.015-in. root gap	1/16	1/16	75	9	15	8
0.064	Square butt, close or 0.020-in. root gap	3/32	3/32	100	9	10	8
0.125	Single V, 75 degrees included angle, root face 1/32 in., 0.045-in. root gap, 2 runs	1/8	3/32 or 1/8	150	6	8	10

3/ HS-25: Arc

Diameter of Rod, in.	Current, amp	Arc Voltage, volts
1/16	40-60	18-22
5/64	50-70	20-24
3/32	60-90	22-26
1/8	80-120	22-26
5/32	90-130	22-26
3/16	110-170	22-26

4/ HS-25: Metal Inert Gas

Base Metal Thickness, in.	Rod Diameter, in.	Current, amp.	Argon Flow, cfh	Travel Speed, ipm
1/8	1/16	275	30	20
1/4	1/16	300	35	16
3/8	1/16	300	35	16

Unique Design: 39 Steel Cylinders Replace One Vessel

IN BRIEF: Off-the-shelf tubing replaced a more expensive single, large, high-pressure vessel in a wind tunnel's air storage receiver.

A DESIGNER CAN CUT COSTS!

That's what Republic Aviation Corporation learned. Republic called in Burns and Roe, Inc., of New York City, to design an air storage receiver for a new wind tunnel. Burns and Roe specialize in supersonic and transonic blowdown tunnels. At first they considered a single, large, welded high pressure vessel. Instead, they designed a lower-cost system by using off-the-shelf high strength seamless steel tubing. They took thirty-nine 21-foot sections and made them into 39 air storage bottles. Their design called for swaging the tubing, seal welding one end of each piece, and then joining all bottles to a common header.

Pump-up pressure in the bottles is 3,000 psig. This is enough for tests made at up to four times the speed of sound (Mach 4). The tests take from 35 seconds at Mach 4 to several minutes at lower flows.

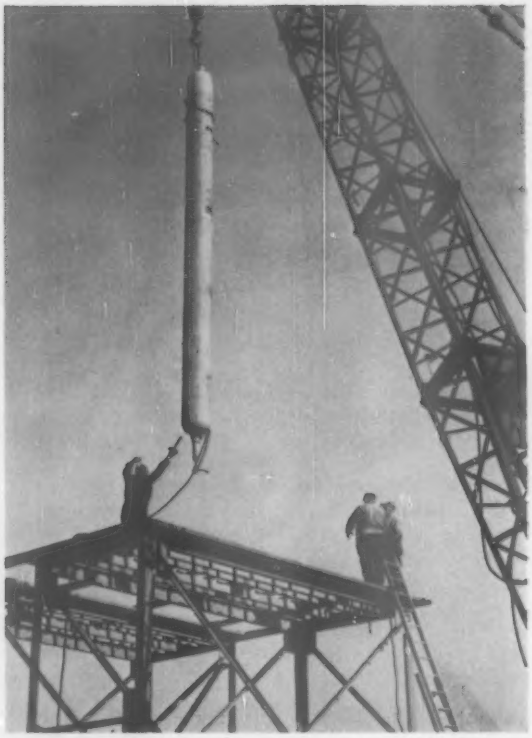
The temperature of the air during the tests must not vary by more than 60° F. This is a difficult requirement, because the air expands and cools as it leaves the bottles. To counteract this cooling (and the Joule-Thompson cooling effect through the throttling valves), Burns and Roe inserted crimped steel plates into the lower third of each cylinder. These plates have a large heat storage capacity and warm the air as it passes.

FABRICATION

U. S. Steel's National Tube Division made the 39 bottles from SA 372-53T Class IV seamless steel tubing. Outside diameter is 18 inches, wall thickness 1.046 inch minimum. National Tube swaged each end, sealed off one end of each tube, and welded a 12-inch-long, 3-inch-diameter (Schedule 160) nipple in the other end.

Welding position	Electrode size (E6010)	Amperes (DC reverse polarity)	Voltage (Minimum)
Horizontal fixed only	1/8	80 - 120	22
	5/32	120 - 160	25
Vertical only	1/8	80 - 120	22
	5/32	120 - 160	25
	3/16	160 - 200	28

WELDING is done according to the National Certified Pipe Welding Bureau's Standard Procedures Specification No. 1.



39 STEEL CYLINDERS like this one make possible a cheaper air storage system.

FIELD WELDING

Almirall & Company, Inc., constructing engineers, did the welding. The company followed the National Certified Pipe Welding Bureau's Standard Procedures Specification No. 1 for metal arc welding carbon steel pipe, valves, fittings, and flanges. See chart for welding details.

Almirall welded the 3-inch-diameter pipe nipples to 10-inch headers using 3-inch saddle-type welding fittings at the connections. They joined seven bottles to each of six headers; three header nipples were capped for future use. Positioning the bottles for welding was simple. The fabricated steel rack in which they are mounted held them in place.

Three headers were then welded to each of two 12-inch main headers. These meet at a 12-inch Y. The result is a common system in which the air from the 39 bottles supplies a single main header. The air from this common system can be sent either to the transonic or supersonic wind tunnel.

All welds were stress relieved. They were heated to 1,150° F with an oxyacetylene flame and air cooled.

The finished system was tested hydrostatically at 4,500 psig. • •

Got a Welding Problem? Read how...

McKay Research Engineers with the cooperation of metallurgists of the steel producer, developed a special welding electrode, McKay AM-355, which solved a costly nuclear Ramjet problem for Lacy Manufacturing Company.

Pittsburgh Steel Company extended the service life of Blooming Mill Guides 900% by using McKay Hardalloy 61 Weld Metal.

Vulcan Manufacturing Company, by using McKay D. C. Titania Stainless Steel Electrodes, got consistently high quality welds in the fabrication of Critical Pumping Weldments.

ABOUT LACY MANUFACTURING COMPANY

Lacy Manufacturing Company, established in 1887, pioneered the supply and erection for steel Storage Tanks in California. Also fabricators of many products required by industry, basically metal plate construction, storage tanks, stacks, pressure vessels, boiler breeching and oil well pumping units. Lacy Manufacturing Company also serves the Aircraft and Missile Industry in requirements for shapes, weldments and prototypes current to today's progress.

APPLICATION DATA

McKay AM-355 Electrodes were used in a variety of sizes to weld plate material as heavy as 3" thick. All welds were made by manual arc welding.

Component of a
Ramjet Engine

McKAY AM-355 ELECTRODES

. . . solve costly Nuclear Ramjet problem at Lacy Manufacturing Company,

Ramjet weldments produced by Lacy Manufacturing Company for The Marquardt Corporation's part of Project Pluto were required to operate at high internal pressure and a temperature well over 1000°F. Conventional stainless steels were not adequate. The recently developed precipitation hardening stainless steel, AM-355, would meet the requirements if an adequate filler metal for the welded seams was available.

New materials normally pose new welding problems and extended delays which could not be tolerated in this high priority project. McKay Research Engineers, working closely with metallurgists of the steel producer, developed a lime coated manual welding Electrode, McKay AM-355, that deposited weld metal with the same metallurgical characteristics as those of the plate material. The use of McKay AM-355 Electrodes simplified welding procedures and insured reliability of the weld deposit. This cooperation between the steel producer and McKay Research Engineers enabled Lacy Manufacturing Company to meet Project Pluto's requirements on time, everytime.

"All welds made with McKay AM-355 Electrodes passed x-ray examinations," said Mr. Michelsen, Shop Superintendent of Lacy Manufacturing Company. "McKay came up with a vitally needed solution to an extremely difficult problem and in a hurry too. Approximately one month from the day we contacted our McKay source, the exact Electrodes needed to meet specifications came into our shop."

Licking welding problems—solving unusual applications and providing excellent customer service are routine at McKay. No matter what you need—Mild, Stainless, Low Hydrogen, or Hard Surfacing Electrodes and Welding Wires—a call to your nearby McKay distributor or representative will bring prompt results.

"Using McKay AM-355 has given us welds which consistently heat treat to a hardness exactly matching that of the base metals. This consistent uniformity saved us at least 25% in time and labor costs," says J. A. "Al" Michelsen, Shop Superintendent, Lacy Manufacturing Company, Los Angeles.

See back page for helpful McKay literature

THE McKAY COMPANY

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ABOUT VULCAN MANUFACTURING COMPANY

Vulcan Manufacturing Company is one of the largest weldment fabricators of pump component parts on the West Coast. The firm has extensive machining facilities and does custom work for process industries in all the 50 states. Vulcan Manufacturing Company has operated from Los Angeles since 1938.

APPLICATION DATA

The primary pump unit is 36″ outside diameter by 15 feet; the secondary unit is 36″ outside diameter by 12 feet. About 1000 pounds of weld metal were required for the 35 to 40 welds in each assembly.

McKAY D.C. TITANIA STAINLESS STEEL ELECTRODES

...*efficiently weld critical pumping weldments*

"We use McKay D. C. Titania Stainless Steel Electrodes wherever possible because we get fewer flaws in the weld deposit," said Mr. Mike Underwood, Shop Superintendent of Vulcan Manufacturing Company, one of West Coast's largest pump weldment fabricators.

In the fabrication of these primary and secondary pumping units for a critical application, Vulcan uses McKay Type 308 and 310 D. C. Titania Electrodes exclusively. All welds have to pass dye penetrant inspection; some welds also are X-rayed, and others are subjected to a helium leak test so critical that it shows up flaws in the parent metal.

"We consistently get high quality welds with McKay Electrodes," said Mr. Underwood. "This is extremely important to us. Sound welds not only save time-consuming re-welding, but help us maintain our standing as a high quality pump weldment fabricator."

Vulcan welders prefer McKay Electrodes because of their smoother flowing and easier cleaning characteristics. The smooth flat beads require less grinding to blend weldments with the parent metal thus reducing production costs.

Got a welding problem? Look to McKay as do other cost and quality conscious fabricating firms. There's a full line of Mild, Stainless, Low Hydrogen, and Hard Surfacing Electrodes and Welding Wires to choose from.

"McKay Electrodes consistently give us superior weld deposits, requiring but a minimum of grinding," said Mr. Mike Underwood, Shop Superintendent.

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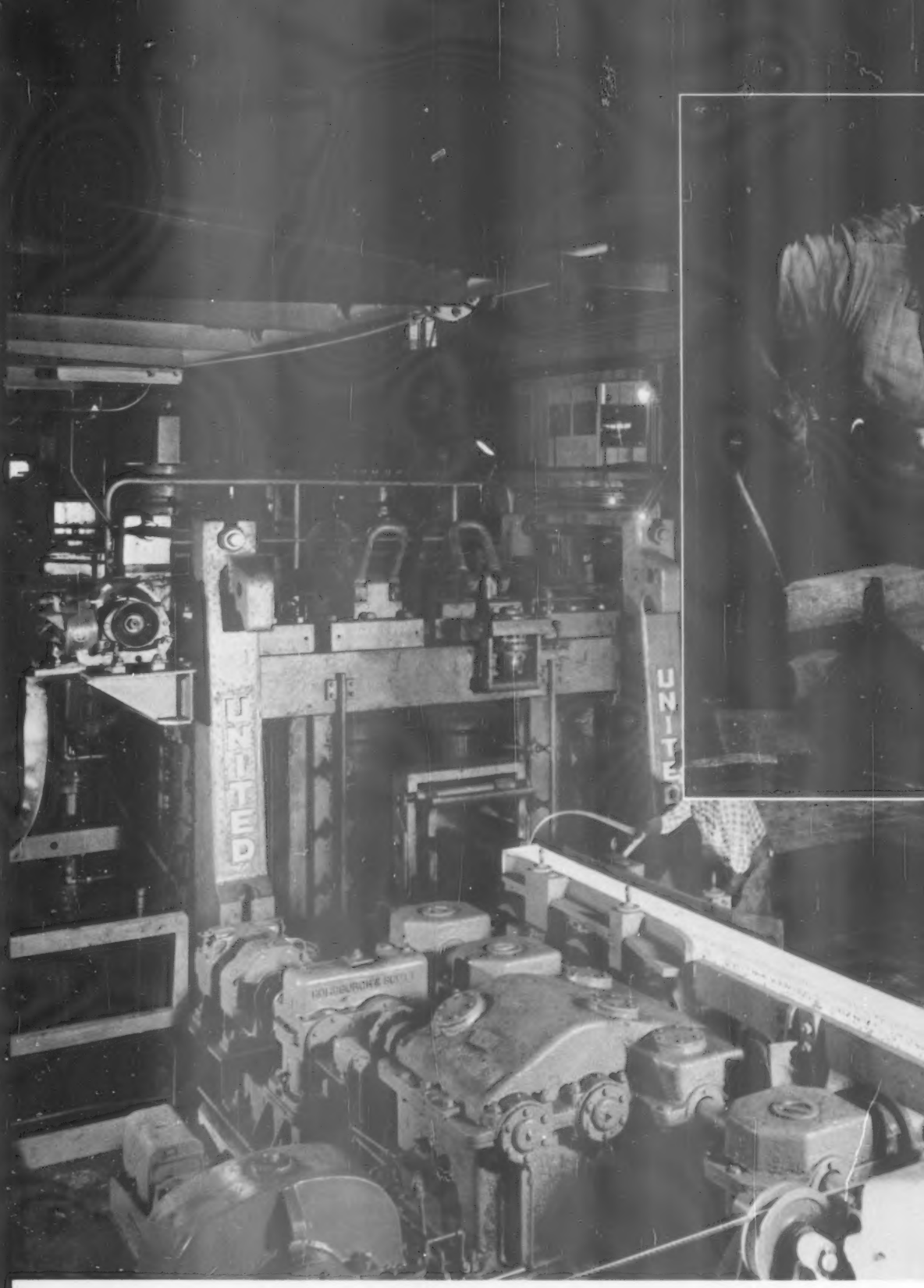

ABOUT PITTSBURGH STEEL COMPANY

"Pittsburgh Steel Company is an integrated producer with general offices in Pittsburgh, Pa., and basic steel-making facilities at Monessen, Pa., with an annual capacity of 1,620,000 ingot tons. Founded in 1901, the company is noted for the high quality of its wire, seamless tube, and flat-rolled products."

APPLICATION DATA

Billet Mill guides were surfaced manually with McKa Hardalloy 61 Electrodes. These Electrodes are specif cally formulated for metal-to-metal wear at high ser ice temperatures.

McKAY HARDALLOY 61 WELD METAL

...extends service life of billet mill guides 900%

"One month is good service life for new, unprotected mill guides subjected to the severe abrasion, shock, and high temperatures of rolling mill operations," said Mr. Ken Geisselhart, Blooming and Billet Mills Superintendent at Pittsburgh Steel Company's Monessen Pa. works. "Guides surfaced with McKay Hardalloy 61 Weld Metal consistently give us nine to twelve months of trouble free service."

The mill guides are essential to the successful operation of all rolling mills. Progressive reduction operations on billets cannot function efficiently and accurately unless the material is properly directed to, or delivered from, the successive rolling passes by the guides. The guide surfaces must be tough to withstand the severe service conditions and mirror smooth so as not to scratch the ingot bar.

"Weld metal deposited by McKay Hardalloy 61 Electrodes is uniformly hard over the entire wear area," said Mr. Geisselhart, "and provides excellent wear resistance as is evident by the 900% longer life span of the surfaced guides over the new unprotected guides. Production downtime and replacement costs have been reduced substantially by the use of surfaced mill guides."

You too can increase the useful life of your equipment and parts which are subjected to abrasion, corrosion or high temperatures, by specifying McKay Hard Surfacing Electrodes and Wires. A McKay Hard Surfacing Field Engineer will be glad to assist you in selecting the right McKay product for the job.

"McKay Hardalloy 61 weld metal best meets the requirements for a smooth, durable finish on our Billet Mill guides," said Mr. Owen Graff, Superintendent, Welding Department.

a McKay
specifi-
igh serv-

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"HELPS" FROM THE McKAY COMPANY

USER-REPORTS—detailed reports on how users of McKay Electrode products save TIME, MONEY, LABOR.

REPORT NO. 104

Explains how O. E. Gooding Company increased welding production 20% in a 4-month period due to faster, more positive bonding of McKay Tube-Alloy 218-0 semi-automatic welding wire, in building up jaw dies and crusher rollers.

For your copy, circle No. 1 on Literature Request Card.

REPORT NO. 106

Step-by-step procedure of how Material Service Corp. combined McKay 11018 Electrodes with T-1 Steel to construct a 7-ton shovel dipper stick, which is stronger and costs less than a new one.

For your copy, circle No. 2 on Literature Request Card.

REPORT NO. 103

Describes how Alpha Tank & Metal Manufacturing Co., fabricator specialists in custom alloys for food, chemical, and petrochemical industries, meets critical specifications with the use of McKay 308 Stainless Electrodes.

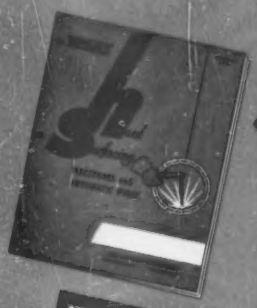
For your copy, circle No. 3 on Literature Request Card.

REPORT NO. 107

Details procedure of how Page Engineering Co. welded a manganese steel lip to a low alloy, hi-strength bucket with McKay Tube-Alloy 218-0 Wire, thereby reducing their costs in producing drag-line buckets by $36,000 per year.

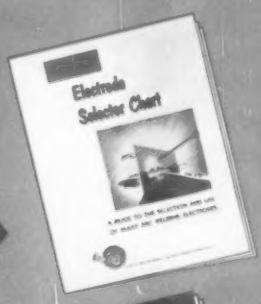
For your copy, circle No. 4 on Literature Request Card.

LITERATURE AVAILABLE



Hard Surfacing Catalog—Contains full information on all McKay Hardalloy Hard Surfacing Electrodes and Tube-Alloy Welding Wires, plus check list of 500 applications.

For your copy circle No. 5 on Literature Request Card.

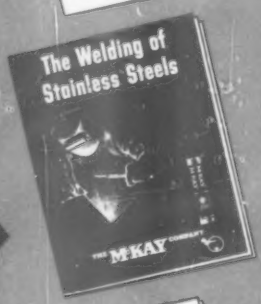


McKay Selector Chart—A complete guide to the selection and use of McKay welding products including all classes of mild steel, stainless steel, special purpose, hard surfacing electrodes, automatic and semi-automatic wires.

For your copy circle No. 6 on Literature Request Card.

The Welding of Mild Steels—Catalogs specifications, operating characteristics, properties, uses and other data about the McKay Mild Steel, Low Alloy, Low Hydrogen Electrodes.

For your copy circle No. 7 on Literature Request Card.



Welding of Stainless Steels—A 24-page book which provides detailed data on chemical analysis, mechanical properties, corrosion resistance and types of electrodes available for welding stainless steels.

For your copy circle No. 8 on Literature Request Card.

Hard Surfacing Manual (Earth Moving Equipment)—This manual provides detailed information and procedures for deposition of alloys for proper build-up and/or hard surfacing of over 30 illustrated parts used for heavy earth moving equipment.

For your copy circle No. 9 on Literature Request Card.

Guide on Welding Stainless Steel—6-page folder contains handy chart on the chemical and physical specifications of McKay Stainless Steel Electrodes.

For your copy circle No. 10 on Literature Request Card.

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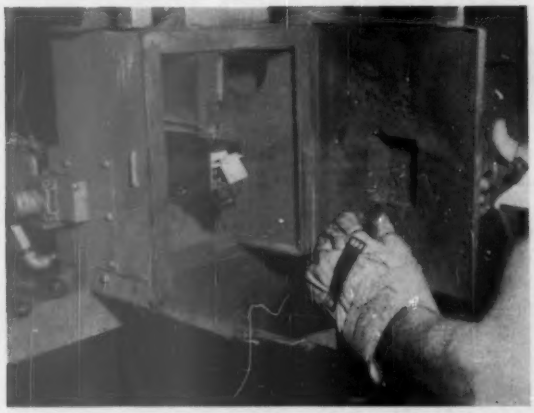
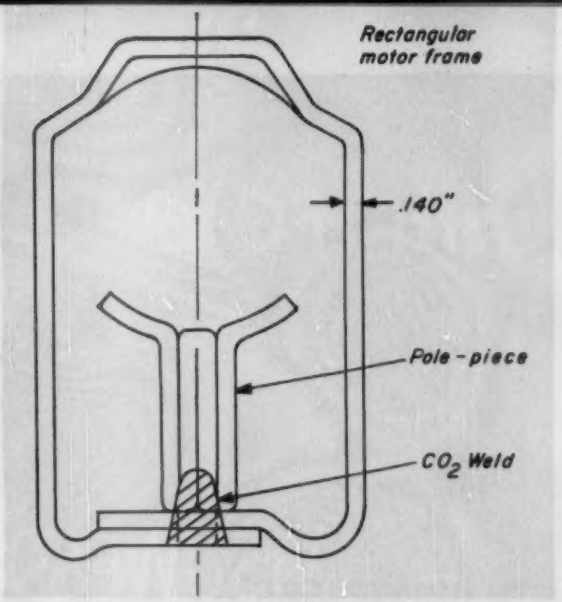
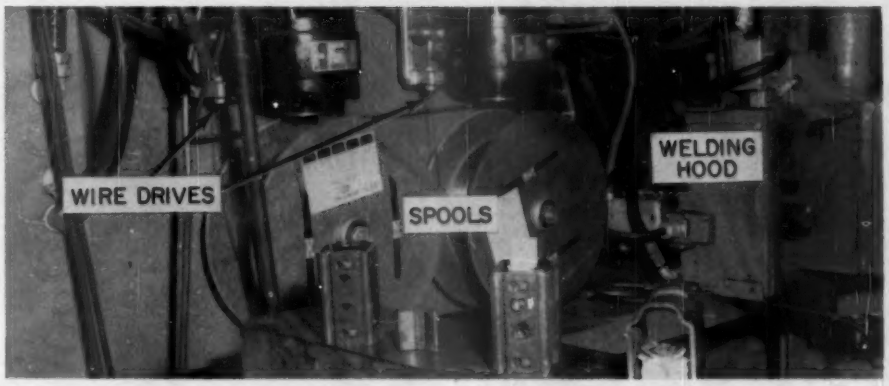


THE WAY TO START this welder is to close the door—the mandrel expands, CO_2 flows, welding power comes on.



TWO MOTOR DRIVES with a common control pull wire from two spools to feed two welding arcs at the same time.



CO_2 Welding Saves GM $8,000 A Month

IN BRIEF: Speed, low cost, and reliability were of first importance in joining a space-saving rectangular motor. Automatic CO_2 welding gave all three.

AUTOMOBILES ARE CRAMMED with electric motors. They run wipers, heaters, defrosters, seats, windows, antennas, and even trunk locks. With so many motors and attachments, it's a wonder there's room for people. But there is. In fact, cars get roomier every year, even though motors are multiplying. How come?

The big reason is that designers have been able to cut motor size drastically so that auto interiors are uncrowded. The Delco Appliance Division of General Motors, in Rochester, N. Y., makes a powerful, but exceptionally slim rectangular motor. What's more, it's dependable and mass produced.

Conveyorized welding systems make 3,000 motors every 8 hours. At the heart are automatic CO_2 welders that join the motor pole-piece to the frame with two, deeply penetrating welds. The operator merely loads the machine, and shuts the door. The rest is automatic.

The frame and pole-piece (see sketch) are pressed from 0.140-inch-thick low-carbon, electrical quality steel. In making the frame, which overlaps at the bottom, Delco punches matching holes through which welds are made into the pole-piece. At the same time, they punch mechanical joints which lock the overlap in alignment for welding.

POLE-PIECE IS STRIP STEEL TOO

The pole-piece is coined from strip, not only to provide an accurate face for the armature, but also, to furnish a solid base, over a half inch thick. They get this thickness by making a double fold.

Delco engineered and built the welding equipment to nestle next to the belt conveyor. At first, they

continued on page 50

WELD FLAWLESSLY and PERFECTLY because with TEC...

- **YOU SAVE on GAS!:** Engineered to expand gas volume and control turbulence for a uniform gas flow.
- **YOU SAVE in PARTS!:** No stock of spare parts necessary. Unit construction in all models.
- **YOU SAVE in TIME!:** See what you weld. Nozzles for every situation.
- **YOU SAVE in LABOR!:** Less weight . . . less fatigue . . . less down time.

TEC — MANUFACTURERS OF VISUWELD EQUIPMENT
TEC TORCH CO., INC.
CARLSTADT, N. J.

For More Information Circle No. 68 on Reader Service Card.

CO_2 WELDING *continued from page 49*

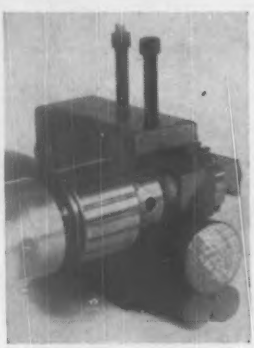
used argon for weld shielding. But it didn't take the engineers and cost people long to learn that CO_2 would be much cheaper. Since the changeover, Delco figures they save over $8,000 a month in gas cost.

At each welding station—and there are five—there are two welding setups consisting of a transformer and a hood. The second setup is a standby.

Each foot-square welding hood has two tubular nozzles (copper) through which the welding wires feed. Separate motor drives pull the wires from reels, but a single control feeds them both. CO_2 gas floods the welds from the side through a fixed-flow orifice. Side feed prevents spatter buildup and it also aims the CO_2 into the welding holes. The fixed-flow orifices control and save gas.

To weld, the operator slips a pole-piece and frame over an expanding horn in the welding hood. Stops line up the welding holes under the torches. The operator shuts the welding hood door, the air-powered horn expands to clamp the parts, and both welds are made. The welds penetrate 3/8 inch into the pole-piece and fill the holes with weld metal. After welding, the horn contracts and ejects the frame down a chute onto the conveyor belt.

Previous to this, coils are put on pole-pieces. Down the line, bearings are welded to end caps, and end caps to frames. This gives Delco alignment that wouldn't be possible if they bolted end caps to the frame. Besides, bolting is more expensive. • •



Cuts Keyseats On the Job!

NEW

Portable

WOODRUFF

Keyseat Cutter

Now you can save hours of valuable time by cutting keyseats right at the job. No need to cut a new replacement shaft or an original shaft on a milling machine . . . this precision KEYSEAT cutter is completely portable, can be used any place you need it. Automatically centers on any shaft 1/2" to 1 1/2" in diameter. Instantly powered with any 1/2" drill. Uses standard Woodruff Keyseat cutters manufactured to A.S.M.E. standards. Only $24.95 less cutter. Send for more information today!

GARY STEEL PRODUCTS CORP.
4400 W. 9th Ave. Gary 4, Indiana

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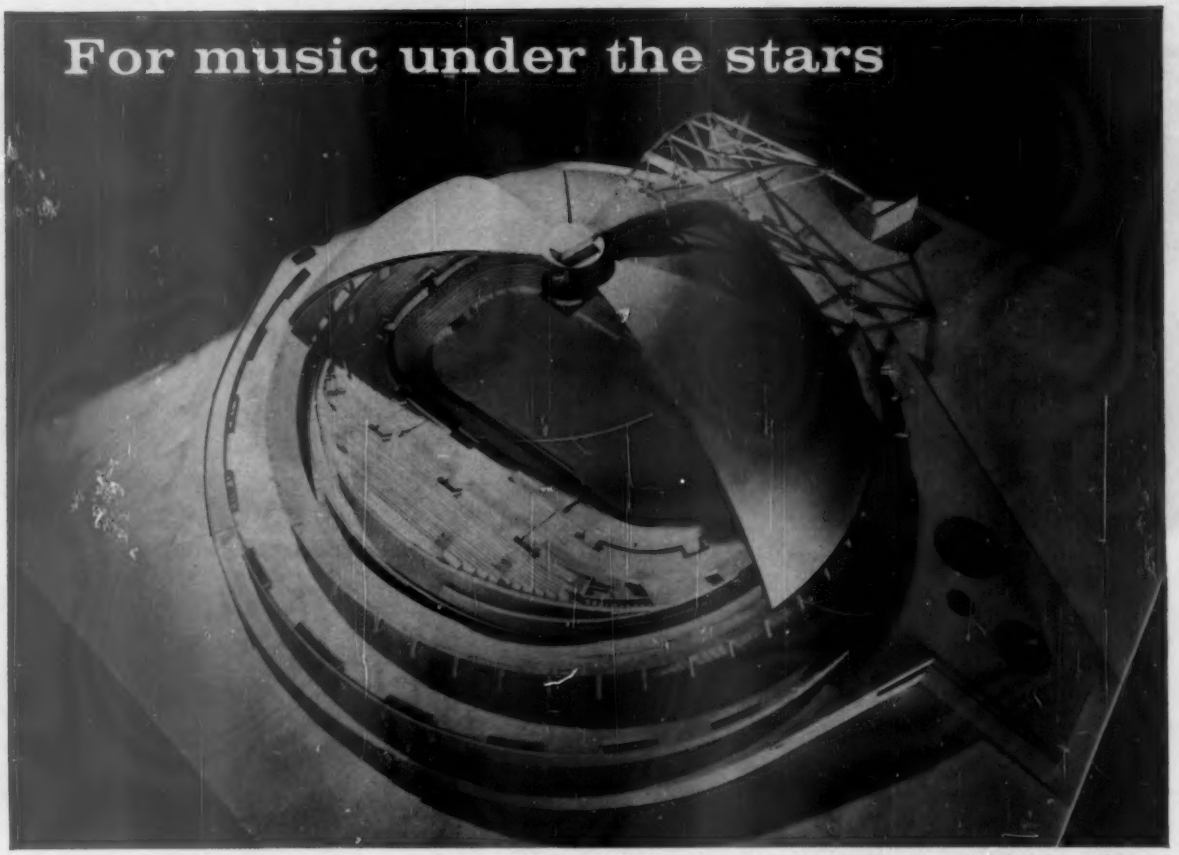
For music under the stars



Dome of Pittsburgh Auditorium, in partly opened position, shows stadium within.

The 400-foot rollback dome of the new Pittsburgh Auditorium is supported by one huge welded cantilever backwork. Welds were proved sound by radiography.

The "leaves" of the great dome over Pittsburgh's new auditorium move on a circular track turning on an overhead pivot. There are no interior supports. When the dome swings open, the anchors of the backwork holding it up are under about 4,000,000-lb. tension, the buttress under 7,000,000-lb. thrust. Every weld in the system is critical.

To assure the integrity of all welds, U.S. Steel's American Bridge Division radiographed them using Kodak Industrial X-ray Film. This radiographic inspection provides a permanent record of the soundness of the welds.

If you would like to learn more about radiography in terms of your business, talk it over with an x-ray dealer, or write us for a Kodak Technical Representative to call.

GOOD NEWS! Kodak Industrial X-ray Film, Type AA and Type M, is now available in the new, convenient Ready Pack. Each sheet—sealed in a light-tight envelope ready for exposure—stays clean. After exposure a rip strip on the envelope makes it easy to open in the darkroom.

EASTMAN KODAK COMPANY
X-ray Division Rochester 4, N.Y.

X-ray shows a sound weld in an I-beam flange supplied by American Bridge Division of the United States Steel Corporation.

Kodak

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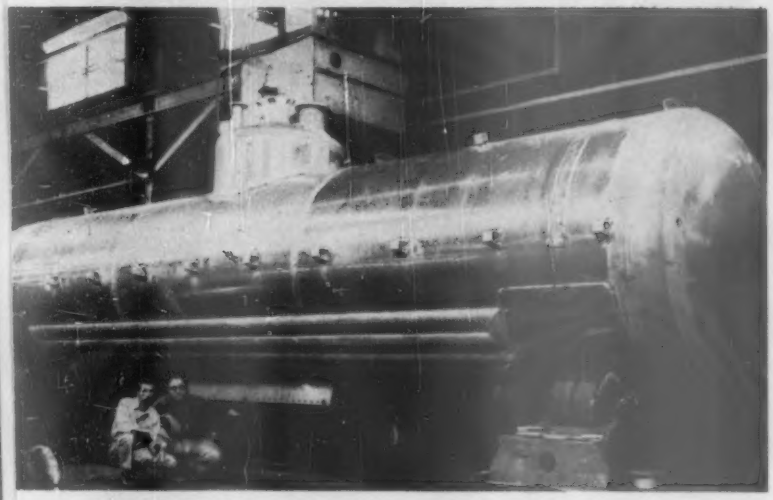


COMPLETED aluminum tank shows dome, heating coils, and anchor beam.

TUNGSTEN ARC CUTTING leaves sharp clean edge on aluminum plate.

Techniques For Fabricating And Welding Aluminum Tank Cars

by **J. F. O'CONNELL,** *chief welding engineer, T. B. Beaird Company, Shreveport, Louisiana*

IN BRIEF: New welding and cutting processes and techniques have reduced the cost of fabricating aluminum tank cars.

WE DESIGN AND FABRICATE aluminum tank cars for North American Car Corp. Leasing companies like that provide the nation's railroads with a variety of cars for carrying different chemicals.

We set up stringent quality controls to make sure these cars can move commercially pure products without contaminating them. The job demanded care during welding and fabricating to keep from marring or contaminating the inner surfaces. And, we had to avoid the surface porosity that is sometimes associated with welding aluminum.

PLATE EDGE PREPARATION

We cut plate to size with automatic tungsten arc equipment. We mounted a cutting torch on a carriage with an automatic cutting control. A 900-amp motor generator with 115 volts (open-circuit) is the power scource. We cut plates at 70 ipm (surface cut) using a gas mixture of 65 percent argon and 35 percent helium.

We cut dome and fitting openings manually with a manual cutting torch and control and a 600-amp motor-generator. Gas mixture is 85 percent argon and 15 helium.

FORMING SHELL PLATES

Before rolling the shell rings, we grind and buff our plate rolls to a smooth, clean finish. Then we cover them with heavy paper to prevent their scarring or contaminating the plate.

After rolling the plates to diameter, we move them to the fabrication bay. We don't tack the longitudinal seams, because there would be excessive oxidation in the joint if we didn't weld it immediately after tacking.

JOINT PREPARATION

This is the most important step in fabricating and welding aluminum vessels that must pass radiographic inspection. We grind and file smooth all edges, remove grease and other contaminants with a commercial solvent. Finally, we buff with a stainless steel power brush.

ASSEMBLING HEADS AND SHELL RINGS

We weld the longitudinal seams inside and out using a square butt joint. We modify this slightly with a light backgouge (⅜ inch by ¼ inch deep) on the outside. This enables us to meet rigid specifications on weld reinforcement. Then we reroll the shells and X-ray the joints.

When we know we have three radiographically-sound rings, we tack the first to an elliptical head

continued on page 54

PAPER-COATED ROLLS protect aluminum surfaces.

HYDRAULIC JACK aligns shell rings for welding.

AUTOMATIC HEAD makes circumferential seam welds.

DESIGN BACKGROUND

MILLIONS OF DOLLARS are spent each year for tank cars, according to R. A. Hay, welding engineer, Reynolds Metals Co. These are made from steel, stainless, copper, and aluminum depending on the products they will carry. The determining factors are: corrosion resistance and weight savings and, sometimes, conductivity and physical properties at low temperatures.

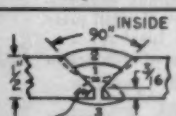
The use of aluminum tank cars has increased greatly for these two reasons: Aluminum cars now in use have given years of trouble-free operation. New welding and cutting processes have reduced fabrication costs.

Aluminum tanks are fabricated according to American Association of Railroads Specification ICC-103 AL-W and to the customer's order.

PARTS LIST

Capacity of car tank:	8,000-gallons
Outside diameter:	79-inches
Overall length:	33-feet, 8⅜ inches
Shell:	Three 10-foot courses
Heads:	79-inch OD; 2:1 ratio elliptical; 5052 aluminum
Two end shell rings:	5052-H-112 aluminum plate
Center shell rings:	Top section: 5052-H-112 aluminum plate Bottom: 5052-H-112 aluminum plate
Dome shell ring:	5052-H-112 aluminum plate
Dome head:	54-inch OD flanged and dished; 5052-0
Anchor beam assembly:	(T-section fabricated) 5052-H-112 aluminum plate
Wear plates:	5052-H-112 aluminum plate
Nozzles and fittings:	A-356 aluminum castings
Unloading device: (fabricated)	1¾-inch and 1¼-inch 6061-T-6 aluminum plate for flanges
External heating coils:	Extruded elliptical shapes, 6063-T-42 aluminum alloy

WELDING PROCEDURES

WELD	JOINT DETAIL	WIRE DIA.	AMPS dcrp	VOLTS	SPEED ipm	GAS FLOW cfh	GAS
INSIDE Long & Circ. (aig)*		3/32"	375	30	14	70	Argon
OUTSIDE Long & Circ. (aig)*		3/32"	400-430	31-32	14-15	70	Argon
INSIDE Closing (mig)**		1/16"	#1-275	27	12	50	Argon
			#2-275	29	9	50	Argon
OUTSIDE Closing (aig)*		3/32"	#3-430	31-32	14-15	70	Argon
EXTERNAL HEATING COILS		1/16"	300	26	24-26	70	Argon

(aig)* Automatic Inert-Gas Consumable Electrode • Filler Metal 5356-Al. Wire
(mig)** Manual Inert-Gas Consumable Electrode • Base Metal 5052-H-112 8"0" Al. Plate

ALUMINUM TANK CARS

continued from page 52

and the second ring to the first. Then, we move the shell to a boom manipulator for the inside and outside circumferential seams. We then return the assembly to the fitting station for tacking the third and final ring. Then back to the automatic welding station to make the circumferential seam. Then we X-ray all circumferential seams.

The final operation on the shell proper is tacking the closing head to the shell. We manually weld the inside (two passes), gouged and automatically welded the outside. Then we X-ray the joint.

DOME ASSEMBLY

We weld the longitudinal seams of the dome shell inside and out using the same procedure as we used on the shell rings. Then we tack the dome head to the shell. The opening for the 18 inch manway is then cut in the dome. This gives us a way to clamp the inverted dome to the face plate of a small positioner for automatic welding. Here, again, we use the same procedure on the shell seams. After we complete the X-ray inspection, we cut the rest of the nozzle opening and put in and weld the fittings. The dome is then ready for assembly to the shell.

HEATING COILS; WEAR AND RUBBING PLATES

At this stage, we tack the extruded elliptical heating coils to the bottom section of the shell. These coils require over 500 feet of continuous ¼ inch fillet welding plus welding of all the mitered cuts at the corners. These coils must withstand 200 psi hydrostatic pressure.

After fitting, we again move the tank to the automatic welding station. We rotate the welding groove about 20° off the centerline so we can use downhand welding on these fillets. At the same time, we make the fillet welds on the wear plates, rubbing plates, and anchor beam assembly with the automatic head.

DOME TO SHELL

The final major step is welding the dome to the shell. We took care to cut the opening in the shell a fraction of an inch smaller than the dome itself. We tailor each opening to fit the dome that is to be inserted. The welding edges are beveled with a weld shaver. This gives us a bright, smooth edge, free of contamination. After preparing all the edges, we set the dome in the shell, align, and tack weld on the outside of the double-V groove. Where there is a gap, we run a stringer bead on the outside and then start welding on the inside. It takes us three or four passes to completely fill the inside groove flush with the surface of the plate. Then we chip the tacks from the outside of the groove. The groove is then gouged down to sound weld metal. Again, we have to make three or four passes to fill the groove on the outside. we make two more passes to reinforce the fillet weld.

NEW CLAMPING CONVENIENCE
with "Jorgensen" HOLD-DOWN CLAMPS

NOW with shielded screw for welding service.

Can be spotted on any work-surface (wood or metal), drill press or "T"-slot table. Ideal for temporary or permanent production set-ups.

Clamp slips "on" and "off" pre-spotted holding-bolt in seconds. It's there when needed, out of the way when not in use. Functions equally well in the middle or near the edge of work area. Doubles as vise along side of bench.

Patented "Jorgensen" steel shield POSITIVELY protects screw against welding "spatter" or other damage.

SOLD THRU DISTRIBUTORS—Write for details on complete line—"Jorgensen" and "Pony" clamps.

ADJUSTABLE CLAMP COMPANY
"The Clamp Folks"
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MECHANIZED SQUARE-BUTT WELDING CONDITIONS

Plate Thickness (In.)	Edge Preparation	Wire Diameter (In.)	Shielding Gas Argon cfh	No. of Passes	Welding Speed (ipm)	Current (amp) DCRP	Voltage (v.)	Approximate Wire Feed Speed (ipm)
1/4	Tungsten arc cut or sheared with edges filed	3/32	80	1	[illegible]	370	24	170
1/4	Same as above	1/16	60	2	35	280	23 - 24	240
3/8	Same as above	3/32	80	1	18	420	24 - 25	200
3/8	Same as above	3/32	80	2	28 - 30	350	24 - 25	155
1/2	Same as above	3/32 or 1/8	100	1	14 - 15	450	25	3/32 wire-210 1/8 wire -125
1/2	Same as above	3/32	80	2	23	430	25	205
5/8	Same as above	3/32	80	2	18	430	25	205
3/4	Same as above	3/32 or 1/8	100	2	16	450	25 - 26	3/32 wire-210 1/8 wire -125
1	Same as above	3/32 or 1/8	100	2	10 - 12	500	25 - 26	3/32 wire-240 1/8 wire -135
1-1/4	Same as above	1/8	100	2	8 - 10	550	26	145
1-1/2	Tungsten arc cut or sheared with edges filed	9/64	100	2	8	590	26	130

WELD REINFORCEMENT can be reduced by grooving or beveling plate edges. Procedures will be the same as above, but travel speed higher and current lower.

SQUARE-BUTT WELDED joints (Nos. 2, 3, and 4 at right) are compared with a conventional Vee-joint (No. 1). Welds 1 and 3 were made using a copper backing strip.

Techniques for faster, cheaper welding of heavy aluminum plate

IN BRIEF: Square-butt welding of 1¼-inch aluminum is done with fewer passes and less total heat input.

HEAVY-WALL ALUMINUM cylinders for the nuclear industry are welded cheaper and faster, with less total heat input. National Steel and Shipbuilding, San Diego, is using the new square-butt welding technique with Sigma welding equipment from Linde Company, Division of Union Carbide Corp.

THE PROBLEM

Welding the 1¼-inch-thick aluminum cylinders used to take these four steps:

1. Prepare open-Vee beveled joints
2. Preheat to 350°F
3. Weld one side, then backchip and weld the opposite side
4. Make several stringer-bead passes to complete the joint

THE SOLUTION

National Steel and Shipbuilding avoids these steps by using square-butt welding. The simplest joint preparation suffices, a clean, square, end-to-joint. A shallow Vee-joint suffices where minimum weld reinforcement is wanted. Single pass welds, one from each side, give full build-up and penetration.

Radiographic tests show 100-percent water-clear welds. This is important in nuclear process equipment. Severe operating conditions demand welds that are free of cracks, pits, inclusions, and surface porosity.

THE PROCESS

Square-butt welding, or high-current welding, was developed by Linde for welding heavy aluminum plate at currents much higher than 400 amps. Earlier attempts to exceed 400 amps resulted in unstable arcs, weld porosity, and severe oxide folds between weld layers.

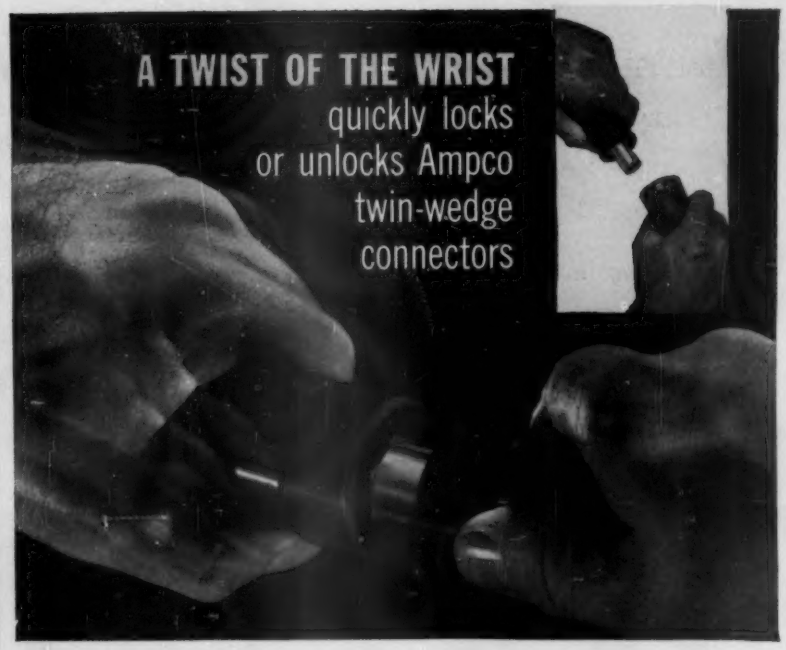
The unstable arc dissappeared with improvements in gas shielding and

gas purity, wire quality, and the slope-controlled power supply.

The higher welding currents (up to 600 amps, d.c. reverse polarity) increase heat input at the weld zone. Porosity disappears because the puddle stays molten long enough for porosity-forming gases to bubble out. But, total heat input is reduced, because one pass is required from each side. The results are minimum distortion, reduced machining, and less scrap.

THE TECHNIQUES

National Steel and Shipbuilding mounts a 30-inch diameter 6061 aluminum cylinder on a positioner beneath a welding head. Joint edges of the 1¼-inch aluminum are square machined for cleanliness. They have a ⅜-inch chamfer for minimum reinforcement. One-pass welds are made from each side at relatively low current (400 amps d.c. reverse polarity) and 27 volts. A 3/32-inch diameter aluminum filler wire is used. Argon shielding flow is 100 cfh. Welding is done at 8 ipm. • •



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For More Information Circle No. 18 on Reader Service Card. W-184

this automatically spaces welds

CONTROL UNIT feeds punched tape through a photoelectric cell. Light passing through holes moves table to position each spot.

this levels work with electrodes

SENSING HEAD is nerve center of positioning table. Welder won't fire until the probes have leveled panel with electrodes.

Punched Tape Whisks 27,000

IN BRIEF: Tape control finds logical application in aircraft spotwelding, where thousands of welds have to be positioned quickly and accurately.

A PUNCHED-TAPE CONTROL system is doubling the output of large spotwelders at Ryan Aeronautical Company, San Diego. It positions thousands of welds on fuselage sections of jet-transport planes, rapidly and accurately. This job used to be done manually, and it took a lot of time to position each weld.

The system, developed for Ryan by General Electro-Mechanical Corp., controls six big custom-built spotwelders. This tape-control is not the fancy (expensive) kind with feedback or memory accessories. It doesn't have to be to keep the welds within a plus or minus 1/32-inch tolerence. This is close enough for top-quality aircraft work.

Ryan tape positions about a third of the 80,000 spotwelds in each fuselage section. The engineers expect to automatically position more and more welds as sturdier fixtures are built.

Punched tapes can issue all the commands needed for 100-percent automatic control. But each machine operator decides when to bypass the tape in favor of manual positioning. When positioning is manual, tape and table movements remain synchronized so no readjustments are necessary to resume automatic positioning.

A typical Ryan tape-controlled spotwelder has a 73-inch by 54-inch throat and is 13½ feet high. Its 3-phase unipolar 250-kva transformer can discharge 100,000 amps of welding current.

NERVE CENTER GIVES WELDING SIGNAL

The nerve center for positioning the welder's work-holding table is a box with four nylon probes, mounted on the bottom electrode. These probes level the fuselage panel with the electrodes (within 1½°), at the spot

EYING sensing head on bottom electrode, operator fires each weld as fast as the fuselage panel is moved and level. Helper, in upper berth, keeps tabs on welding from the top and watches edge-distance tracing, if used.

Spotwelds Into Position

dictated by the tape. Two of the probes control vertical motions of the table's right and left elevators. The other two operate a tilting mechanism, which turns trunnions supporting the frame in which the panel is mounted.

To protect the panel from scratches during positioning, the table raises it automatically to a level position, 1/8 inch above the lower electrode. The operator cannot fire the welder until the level signal is received from the probes. The welding button works only when the probes show that the panel is positioned. The table lowers until the panel touches the bottom electrode. Then it electronically locks out and the weld is made.

After welding, the upper electrode raises, the welder locks out, and the table tape control takes command again. The table raises and automatically moves to the next welding position.

Besides manual and tape positioning, the welder can make equally-spaced welds repeatedly. The device that enables it to do this is called an increment spacer. The increment spacer is also used to prepare punched tapes for variably-spaced welds.

WHEEL HOLDS EDGE DISTANCE ON CURVES

When a row of spots is not in a straight line a tracing head is used to hold spot edge distance from the edge of a doubler or to center a row of spots in a stringer. The head, mounted next to the upper electrode of the welder, has a wheel that follows the edge of a doubler or stiffener. The welding table then will move in two directions. One direction is controlled by the tracer. The other, tape directed, positions the spot.

Besides reducing sharply fuselage panel spot welding time, the tape-controlled welders consistently produce high quality, fatigue-resistant welds. And the welding operators needed little special training to operate the machines. Each machine was welding panels almost as soon as it was certified for aircraft work. • •

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Circle No. 70 on Reader Service Card.

Filler wire is key to new CO_2 spray arc welding process

by C. R. SIBLEY,
Equipment Engrg. & Development Dept., Air Reduction Sales Co.

IN BRIEF: Adjusting filler wire composition gives sound weld metal that can be deposited with an open arc.

OUR Co_2 SPRAY ARC welding process depends entirely on the filler wire for the spray-type metal transfer. We treat the wire with a dilute solution of two alkali-metal compounds. This leaves an extremely thin coating that does not interfere with electrical contact between the wire and the contact tube. The wire is used in standard gas-shielded metal-arc welding equipment.

The arc we get in straight polarity DC operation is similar to the spatter-free spray transfer that is characteristic of the argon-shielded reverse polarity arc.

We adjusted wire composition to deposit sound weld metal with an open arc. The arc overcomes the undesirable high, narrow weld reinforcement common to the buried arc technique. The operator can make multipass welds in heavy sections with no more than wire brush cleaning between passes. The manganese and silicon in the wire oxidizes to give a complex oxide slag on the weld surface. This protects the hot weld from the air. It also helps form a smooth surface. However, the slag surface is very thin and seems to free itself as the weld cools.

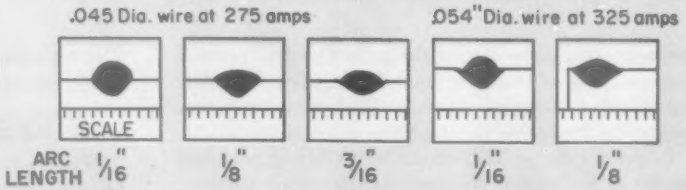
For a given set of welding conditions, the arc characteristic curve is independent of the type of power supply used. We found we could keep a stable arc only at the current and voltage obtained at a point of intersection of the arc characteristic

continued on page 62

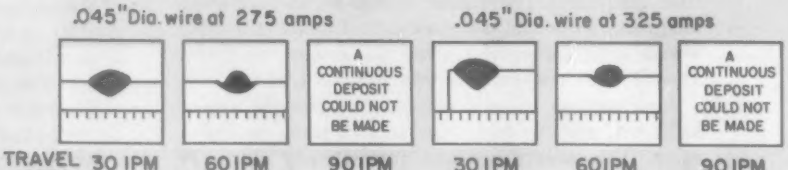
Effect of weld variables on bead shape and penetration

Note: scale 1/8" increments

How arc length changes bead shape and penetration...



How travel speed changes bead shape and penetration...


.045" Dia. wire at 275 amps
.045" Dia. wire at 325 amps
A CONTINUOUS DEPOSIT COULD NOT BE MADE
A CONTINUOUS DEPOSIT COULD NOT BE MADE
TRAVEL SPEED 30 IPM 60 IPM 90 IPM 30 IPM 60 IPM 90 IPM

How gun angle changes bead shape and penetration...

.045" Dia. wire at 275 amps
Electrode stick out: 5/8"
Arc length 1/8"
Travel speed 30 IPM

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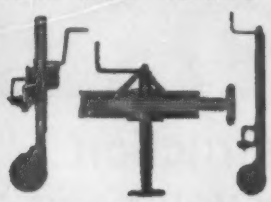

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Circle No. 41 on Reader Service Card.

SEMI-AUTOMATIC WELDING *continued from page 60*

WELD TYPE	Plate Size	Shielding Gas	Wire Size	Amps	Volt	Wire Feed Speed	Stick Out	Arc Length
Horizontal, Fillet, lap	1/4", 1/2"	CO_2	0.054"	270-280	20-22	234 ipm	3/4"	1/16"
Horizontal, Fillet, lap	1/8"	CO_2	0.045"	240-250	18-20	224 ipm	1/2"	1/16"
Vertical Down Fillets	1/8", 1/4"	CO_2	0.045"	250-260	20-22	224 ipm	3/4"	1/16"
Overhead Fillets	1/4"							

TYPICAL SETTINGS for different weld joints and different metal thicknesses.

curve and the power supply characteristic curve. When the machine settings are at the particular points at which a transition from drop to spray transfer occurs, the transition current is considerably higher for a CAV than for a drooping machine.

ADVANTAGES

Our process has these advantages:

1. It transfers metal by spray transfer at rates similar to those of an argon shielded arc but with the higher wire burn off characteristic of CO_2.
2. There is practically no spatter when you keep proper welding conditions.
3. The easy-to-manipulate open arc gives operators complete visibility.
4. Bead appearance is uniform; it's similar to argon-shielded deposits.
5. Weld's mechanical properties are equivalent to an E7OXX deposit.
6. Slag can be removed by wire brushing.
7. Process can be used manually or it can be mechanized.

LIMITATIONS

Our process does have these limitations:

1. The weld pool is very fluid and limits the process to downhand welding.
2. Power sources are limited to drooping characteristics (preferred) and CAV machines.
3. Fit-up must be good; you cannot weld irregular gaps.
4. Arc lengths are critical and must be kept at about ⅛-inch.
5. Extremely high current levels lessen weld quality.
6. Wire stick-out should not exceed ½ inch. Long stick-out spoils bead contour and can influence the porosity level.

APPLICATIONS

Because of its similarity to argon-shielded steel welding, this process can be used in fields with these requirements: low hydrogen deposits, excellent mechanical properties, good weld bead appearance, low spatter level, freedom from inclusions and voids, reduced cleaning costs, high duty cycle, high deposition rates.

The pressure vessel and tankage fabricating industries could use this process. Although submerged arc and hot rods are used very effectively on most of this work, materials up to ½ inch in cross section with joint modification could be welded with this process on a competitive basis.

Other applications might include shop fabrication of structural steel, earthmoving equipment, truck chassis and bodies, gas piping, and tubular structures.

MANUAL WELDING

We welded a series of plug, fillet and lap joints using 0.045-inch-diameter welding wire and a drooping-characteristic rectifier welder of 400 amp capacity. We found we could best control the weld metal by holding a short visual spray arc about 1/16 inch long. Longer arc lengths (1/16 to ¼ inch) produced more spatter and a rougher deposit. We used a current of 250 amperes with the 0.045 inch wire; about 300 amps was best for 0.054 inch wire.

We made horizontal, fillet, and lap welds in ¼-inch plate. The welds were smooth, flat, and not undercut. We welded forehand, holding the gun at a 20° to 25° lead angle. We tilted it about 60° from the horizontal leg. We had to maintain rapid travel speed (about 20 ipm) to prevent the weld metal from rolling out of the joint and causing a sag on the horizontal leg. In making similar

welds on ⅛ inch plates we had to keep the travel speed up to prevent weld metal roll-out.

We also made vertical-down fillet welds in ¼- and ⅛-inch plate and overhead fillets in ¼-inch plate. These fillets were small (about ⅛ inch); travel had to be kept at 30 ipm to prevent uneven surfaces.

MACHINE WELDING

We ran the 0.045 and 0.054 welding wire through a welding head to see how the melting rate varied with current and electrode stick-out. The smallest current was governed by the transition point from drop to spray transfer for each diameter. The highest current was determined by the generation of excessive spatter due to jet rotation of the arc or instability in the arc which caused it to bounce. We got melting rates of about 5 to 18 pounds an hour with either wire diameter in the stick-out range we explored (⅜, ⅝ and ⅞ inch with ⅛ inch arc length).

We also deposited weld beads with the welding head to determine the range of operation with a fixed stick-out of ⅝ inch. The current was varied between the minimum required to produce spray transfer and the maximum which would deposit a satisfactory bead. We explored the effect of arc length, travel speed and angle of the gun.

Uniform continuous deposits were made over a wide range of current at a travel speed of 30 ipm. However, increases in travel speed to 60 and 90 ipm narrowed the useful current range to those values just above the current necessary to develop spray transfer. This was true regardless of the arc length that was used. The practical limit of speed for quality deposits is somewhat lower than 60 ipm.

The penetration of bead welds increased with welding current. For a given arc length and travel speed, we got deepest penetration with 5° lag angle. We got shallowest penetration with the 5° lead angle. Increasing the arc length decreased the penetration at the same travel speed and current, although the change was slight. An increase in welding speed from 30 ipm to 60 ipm caused a considerable decrease in the plate penetration, although the penetration was deepest with the 5° lag angle. • •

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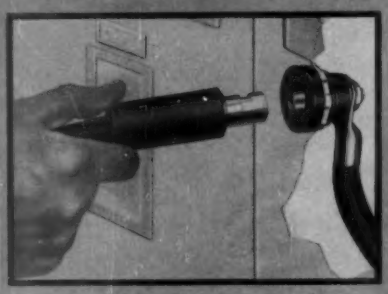

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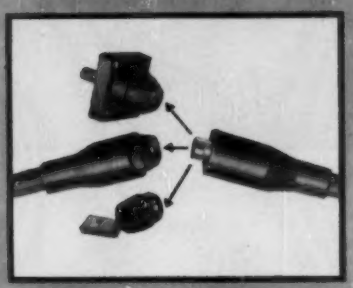

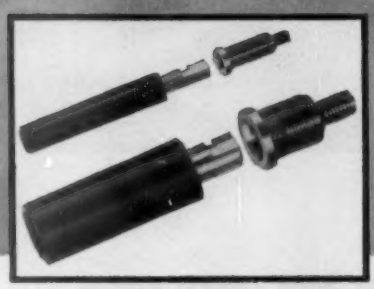

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For More Information Circle No. 24 on Reader Service Card.

4 Methods For

SALT BATH BRAZING (above) gives rapid, uniform heat.

LUMINOUS WALL FURNACE BRAZING (right) is used for large parts with moderate contours.

DIE QUENCH BRAZING (opposite page) does the best job on flat panels.

IN BRIEF: North American Aviation investigated four possible methods for brazing the B-70's stainless honeycomb panels; they then picked all four.

BRAZED STAINLESS steel honeycomb panels make up 75 percent of the surface of the B-70 Valkyrie jet bomber. Its being made by North American Aviation's Los Angeles Division.

These panels are made by brazing thin (down to 0.006 inch) facing sheets to honeycomb cores. The panels are almost as strong as solid steel, but they are many times lighter, and they will resist the 600°F heat the bomber is expected to develop when flying at 2,000 mph. The panels are smooth surfaces, resist vibration and corrosion.

DESIGN BACKGROUND

North American is making panels from a new precipitation-hardening steel, PH 15-7 Mo. It contains 15 percent nickel, 7 percent chromium, and some molybdenum. It is heat treated as a part of the brazing cycle. Minimum yield strength is 200,000 psi, ultimate tensile strength from 225,000 to 260,000 psi.

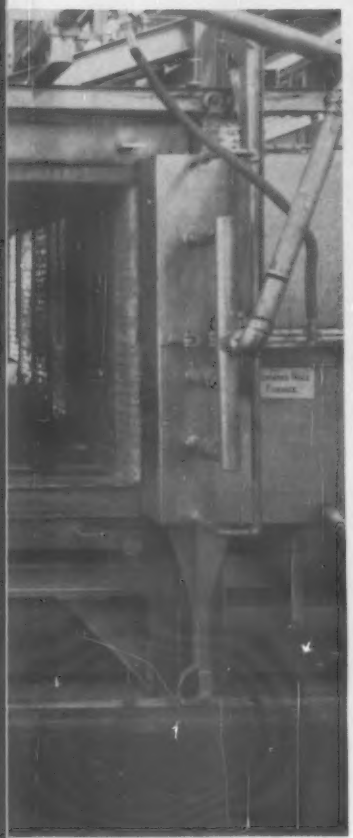
North American's Engineering Department first designed a variety of pilot assemblies and panels, resembling the complexity of the B-70's parts. They were used to establish a reasonable workload for the brazing manufacturing development teams.

At the same time North American gave contracts to companies to produce similar pilot components.

FOUR BRAZING METHODS

Finally, North American selected four methods for brazing at 1625°F, using silver-copper alloys. Each had advantages in making parts with high mechanical properties. They are luminous wall, furnaceless (electric blanket), salt bath, and die quench brazing. Here's what North American learned about them:

Brazing B-70 Stainless Honeycombs



Luminous wall furnace brazing is for large parts with moderate contours. Mixed gas and air are blown through the furnace walls, made of porous refractory brick. The fuel mixture burns as it emerges from the inner brick surfaces. The walls, doors, and part of the floor become a large, incandescent burner that gives intense heat rapidly. When the gas valve is turned off, air continues to blow into the furnace, cooling the brazed panels.

Panels are encased in the inner part of a double retort. The outer retort holds a graphite block that supports the inner retort. An argon atmosphere is maintained within these retorts under vacuum pressure. The pressure is changed to suit time and temperature requirements. The retorts stay sealed during subsequent deep freeze and heat age heat-treating.

Furnaceless brazing is used for severely contoured parts and offers close temperature control. Electrically-heated flexible blankets are draped over a single retort containing parts to be brazed. A new and efficient castable ceramic material controls panel shapes.

Salt bath brazing is used primarily on parts that need uniform heating. The parts are encased in a single retort and a static argon atmosphere. Graphite blocks hold the retort in proper position. The assembly is dipped directly into molten barium and sodium salt, getting very rapid heat-up.

Die quench brazing is the most rapid and economical method. It does the best job on flat panels. Components are encased in a single retort and a static argon atmosphere. The retort is charged into a furnace which has been preheated to 1625°F. This brings the retort up to brazing temperature in a hurry. The panel is then transferred to a press and clamped between the faces of a water-cooled Kirksite die. This cools the part rapidly, holds it to shape, and improves its metallurgical characteristics. • •

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- **Prepares aluminum and stainless for welding.**
- **Removes scale and oxides before or after welding.**

Eliminate costly, time-consuming grinding, scratch-brushing, or sanding on stainless steel. Simply wipe oxide off with one or two strokes of hand applicator. Clean small parts by dipping.

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No Grinding Necessary After Cut. One Stroke Cycle Clutch Operated by Hand or Foot.

The Bateman "Bantam" cuts 2" x 2" x ¼" angles and ¼" x 4" flats. Standard punches will fit this machine. The Coper will cope 1¼" through ⅛" material. It will punch ½" hole through ¼" material. With the clutch open, the Bantam will make 44 strokes per minute. It is made of high-grade cast iron, with the clutch, pin and dog made of hardened steel. The blades are made with tool steel. It is powered with a fly wheel and gear drive, and uses a small ¾ hp motor, 1750 rpm.

Bateman Bantam with punch....$575.00
Shear only $495.00
Shipping wt. 750 lbs.

BATEMAN FOUNDRY & MACHINE
MINERAL WELLS, TEXAS

Circle No. 22 on Reader Service Card.

WORN CAST IRON GEAR is built-up in place as . . .

Nickel-silver brazing saves $2,600

IN BRIEF: Repairing a worn bull gear also eliminated a 4-month wait for a replacement part.

THE BALL-MILL'S cast iron bull gear had worn teeth. The gear was eight feet across and a foot thick. Replacing it would cost $3,000. Installation would add $1,000, freight $200. Worst of all, it would take 4 months to get a new gear. Meanwhile, the ball-mill would stand idle at the gravel plant of A. Teichart & Sons, Perkins, Calif.

William Clayton, plant superintendent, thought he might be able to build-up the teeth. He called in James Kelley of Moore's Welding Supply Co. for advice. Clayton and Kelley decided to build-up the worn teeth without removing the gear. They used a flux-coated nickel-silver build-up rod made by All-State Welding Alloys Company, Inc.

The job took 400 lb. of alloy costing $800. Oxygen and acetylene (25,000 cubic feet) cost $500, labor $300. The whole job cost $1,600, $2,600 less than a new gear. Production was held up only 160 hours instead of 4 months.

The operator preheated the gear teeth to 600°F. A brazing flux with a temperature range of 1480°F. to 2200°F. was painted on the area to be built up. When the brazing temperature was reached, the operator deposited the alloy, playing the flame on the deposit. Then he flowed out the filler metal with a semicircular motion of the oxy-acetylene torch.

Deposits were smooth enough to eliminate any machining or grinding. The alloy has 10 to 14 times the wearability of ordinary steel and can be remelted without loss of toughness. As deposited, hardness is 110 Brinell. Work hardening increases this to 200 Brinell. The alloy's tensile strength is 80,000 psi and it develops shear strength of 180,000 psi. Working temperature is 1250°F. to 1750°F.

"There is no visible wear after a year of continuous use," Superintendent Clayton reports. • •

6 miller WELDERS YOU SHOULD KNOW ABOUT

AEA-200-L gasoline engine driven welder/power plant/pipe thawer. 225 amperes welding current; 1 KW of 115v d-c; 5 KW of 115/230v a-c.

AD-225-L gasoline engine driven AC/DC welder/power plant. 300 amperes a-c or 225 amperes d-c welding current; 7 KW of 115/230v a-c; 1 KW of 115v d-c.

Gold Star SR Series, 3 phase rectifier type d-c welders in four models from 200 to 600 amperes. This is probably the most reliable, versatile and best performing all-around welder ever designed.

SRH — The famous Miller Gold Star series in a low silhouette welder for stacking, paralleling or to conserve space.

250 AC/DC combination transformer rectifier welder. Operates from single phase service to bring new standards of welding performance to everyone. Two a-c and two d-c ranges.

M-295 — new wide range a-c welder of horizontal design. Two welding ranges of 25-115 amperes and 80-295 amperes which handle all metals from light gauge to heavy plate.

Complete specifications on any of the above illustrated Miller welders will be sent promptly upon request. Also available are free copies of "A Full Line of Fine Welders" — a booklet illustrating and describing all our welders.

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Circle No. 21 on Reader Service Card.

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CARBON ARC-AIR JET GOUGING

KEEN-CUTS—for the best characteristics of carbon and graphite in a carbon arc cutting electrode. Higher current capacity ... longer life ... shorter cutting time ... greater material removal ... smooth surface gouge ... controllable accuracy ... hot stable cutting arc ... elimination of smoke and gases.

And they're low in cost. Try BECKER KEEN-CUT ELECTRODES—black or copper coated, standard diameters, 12" lengths in 150 to 1400 amp. range—for the most efficient, labor-saving electrode in carbon arc/compressed air cutting.

A COMPLETE LINE OF CARBON AND GRAPHITE WELDING SUPPLIES—carbon and graphite electrodes, carbon rods and plates, welding paste, graphite cores and chills, graphite powder and particles of any mesh.

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Illustrated: P-63 Oxygen Manifolding Pigtail (Silver Soldered)

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To manifold 2 cylinders, use 1 Coupler Tee and 1 Pigtail . . . 3 cylinders . . . 2 Tees and 2 Pigtails. Thereafter, add 1 Tee and 1 Pigtail for each cylinder added to bank of cylinders. WRITE FOR CATALOG PRICE SHEET.

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FREE Send for informative brochure "Welding Hose Care & Repair".

In Canada: Fibre-Metal (Canada) Ltd., Toronto

Circle No. 74 on Reader Service Card.

REFERENCE DATA *catalogs, handbooks, manuals*

ELECTRODE COOLING is the subject of an illustrated case study, punched for easy insertion in a shop notebook. Available from The Rosaen Co., study explains how Tell-Tale filter makes resistance welding electrodes last by insuring clean water coolant.

Circle No. 300 on Reader Service Card.

"CRAFTSMANSHIP IN STEEL" is the title of a new brochure describing the products and world-wide services of Chicago Bridge & Iron Co. The illustrated publication tells of the company's capacities in design, fabrication and construction of structures.

Circle No. 301 on Reader Service Card.

RESISTANCE WELDING data is contained in a 28-page catalog available from Hercules Welding Products Co. Included are recommendations for efficient welding, specifications and dimensions for all types of wheels, tips, and holders.

Circle No. 43 on Reader Service Card.

SIX-PAGE FOLDOUT from A. O. Smith Corp. explains and illustrates the advantages of multi-arc welding and lists features of equipment. Facts and figures show how single units can amply power many arcs and produce big savings in money and space.

Circle No. 302 on Reader Service Card.

ELECTRICAL CALCULATIONS are made simple with the use of an eight-page brochure on resistance welders. This brochure, printed by The Taylor Winfield Corporation, tabulates all figures needed to establish minimum kva ratings.

Circle No. 303 on Reader Service Card.

ELECTRON BEAM WELDER is the topic of a pamphlet from High Vacuum Equipment Corporation. The welder is fully described and its features, theory, applications, and advantages are listed. Principle of the Beamatron follows the basic design of the cathode ray tube.

Circle No. 304 on Reader Service Card.

CONTROLLED ANGLE TORCH for tungsten inert gas arc welding is that can be adjusted manually to any angle or extended to reach featured in Catalog WC-60. Described and illustrated is a new torch hidden recesses. Manufacturer is Falstrom Company.

Circle No. 37 on Reader Service Card.

STUD WELDING, equipment, and studs are the subject of a price, specifications, and operation manual from Shielded Stud Welding Co. Manual explains theory and practice, and how to make the most efficient welds.

Circle No. 305 on Reader Service Card.

SQUIRTMOBILE is described in a bulletin from the Lincoln Electric Company. This trackless carriage for Lincoln's Squirt welder is designed to make long submerged arc welds. It is magnetically supported to hold it tightly to the work to prevent slip and bounce.

Circle No. 306 on Reader Service Card.

FACTS AT YOUR FINGERTIPS: *If you want copies of the catalogs featured on these pages, just circle the appropriate numbers on the bound-in Reader Service Card. We'll do the rest.*

CUT-OFF WHEELS are specified for best use in a catalog sheet by Bay State Abrasive Products Co. Both reinforced and non-reinforced cut-off wheels are featured.

Circle No. 319 on Reader Service Card.

PORTABLE BLAST CLEANERS that work on a limited air supply are featured in a folder available from Bren Weld Corp. Specifications, parts lists, prices, and applications are given for the new BC-1 Blast Cleaner.

Circle No. 320 on Reader Service Card.

SEAM WELDER ILLUSTRATIONS and dimensions within a brochure by Sciaky Bros., Inc., help to describe their Type MPT-2 seam welder. The welder is designed for a wide range of welding applications.

Circle No. 321 on Reader Service Card.

INDUSTRIAL GAS service is explained in a brochure prepared by Burdett Oxygen Co. Six advantages leading to lower gas costs and better methods are described and illustrated.

Circle No. 322 on Reader Service Card.

BENCH WELDERS bulletin, in color, covers a line of spot welders. It illustrates and describes the welders in capacities from 5 to 50 kva. The bulletin is released by The Federal Machine & Welder Co.

Circle No. 323 on Reader Service Card.

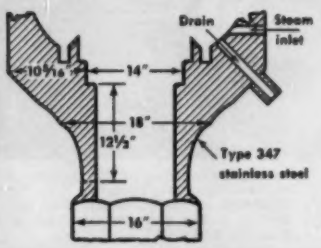
ELECTRON TUBE CATALOG issued by the Amperex Electronic Corporation tells of their line of industrial and commercial tubes. Included are descriptions and basic specs.

Circle No. 324 on Reader Service Card.

INDUCTION HEATING EQUIPMENT is featured in a 52-page catalog-handbook by Induction Heating Corporation. The book pictures the latest developments in this field. Included are illustrations of a wide range of equipment for hardening, brazing, forging, soldering, annealing, and shrink fitting.

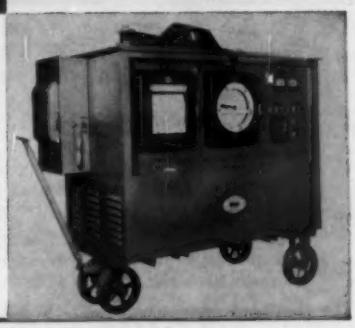
Circle No. 325 on Reader Service Card.

Profit through E.A.I. Research



Uniform, through-and-through heating of the thickest sections of the big stainless steel valves was provided by the Smith-Dolan method, with precision control of temperatures (2-hour dwell at 1900°F.). Drawing shows cross-sectional dimensions.

Standard Smith-Dolan units come equipped with eye hooks and wheels for easy portability, and with instrumentation for recording permanent charts of the heat run.



SMITH-DOLAN On-the-Job HEAT TREATMENT

Solution to Weld Embrittlement Problem at Consolidated Edison

Public utilities are among the largest users of the Smith-Dolan System of Low-Frequency Induction Heating. They want to keep their service uninterrupted, their costs low, and they find that this portable system simplifies the problem of pre-heating and post-annealing in producing sound welds, and in making dependable repairs.

A typical application of the system by a public utility was described in a recent article in Welding Design & Fabrication.* At Consolidated Edison's No. 10 Turbine Generating Station in New York City, two large steam pressure valves made of Type 347 stainless had to be repaired because of weld embrittlement. Removal to the shop for heat treatment would have proved costly and time taking. With the Smith-Dolan portable units, the work was completed on the job within 12 hours.

Learn about the savings and other benefits your company can obtain from the Smith-Dolan System. It is today's most versatile heat treating method, simplifies and upgrades work quality in numerous applications. Write for brochure, "Smith-Dolan System of Low-Frequency Induction Heating."

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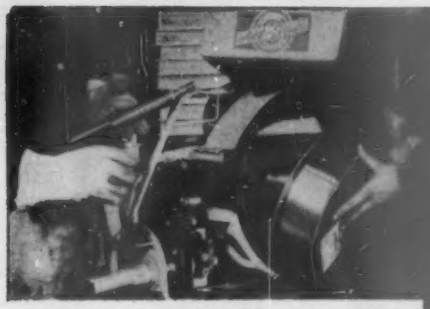
For More Information Circle No. 15 on Reader Service Card.



Loading 10 lb. spool of #4043 aluminum wire at Michael Flynn Manufacturing Co., Philadelphia. Aluminum in this particular spool was used in welding curtain walls for skyscraper at 2 Broadway, New York City.

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All-State Spoolarc

SPOOLED ALUMINUM

in all grades, all types
precision layer level
wound on
1 lb. and 10 lb. spools

Wire goes from extrusion and light draw to ALL-STATE'S precision spooling machines where it is layer level wound for smooth, trouble-free welds.

Types available: 1100, 4043, 5052, 5154, 5183, 5356, 5556, 6061, 6063, *355,* 356, 716, 718.

Precision spooled in these sizes: .030, .040, 3/64, 1/16, 3/32, 1/8.
*down to 1/16 only

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For fast, precision pipe fabrication. Locate any degree from one degree to 360 degrees and establish a true center line in less than one minute. For centering, quartering or eighthing any size pipe. Automatic punch. Cuts back-charges and pipe salvaging to a minimum. Cuts labor time by as much as 90 per cent.

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Distributor Inquiries Invited

For More Information Circle No. 56 on Reader Service Card.

USEFUL LITERATURE *continued*

"GUIDE TO POSITIONING EQUIPMENT" is the title of an illustrated 16-page booklet put out by Ransome Co. Included are valuable discussions and tables on the use and capacities of turning rolls, positioners, and manipulators.

Circle No. 307 on Reader Service Card.

AUTOMATED FLAME-CUTTING machine which can reproduce from a simple pencil sketch on ordinary paper, is described and illustrated in an 8-page booklet from Linde Co. Floor plans and cutting ranges are given for the new Oxweld CM-56.

Circle No. 308 on Reader Service Card.

A CENTER FINDER for fast, accurate pipe joint layouts is featured in a pocket-size brochure from Manning Mfg. Co. Described and illustrated is the tool's automatic punch and dual fluid level.

Circle No. 56 on Reader Service Card.

SADDLE FITTINGS for economical, high-strength branch connections are featured in a folder from Allied Piping Products Co., Inc. Folder 5-60 gives complete specifications, prices, and illustrates results of destructive tests.

Circle No. 309 on Reader Service Card.

CORROSIVE EFFECTS of various materials on 16 types of metals are shown in Corrosion Data Charts published by Nooter Corporation. The charts were prepared with the help of research laboratories throughout the nation.

Circle No. 310 on Reader Service Card.

SUBCONTRACTING of small precision weldments or welding up to 80 ton parts is the subject of literature available from The Morgan Engineering Co. The nationally known facilities, experience, and craftsmanship of the Morgan plant are among features discussed.

Circle No. 61 on Reader Service Card.

PORTABLE BELT GRINDER to hog, blend or finish metal faster is featured in literature from ARO Equipment Corp. This air powered tool can rough grind and finish in one operation.

Circle No. 20 on Reader Service Card.

STRESS FORMING on a shallow draw press is described and illustrated in a booklet from Cyril Bath Co. This booklet explains how the press produces a stronger, lighter, cheaper product.

Circle No. 23 on Reader Service Card.

BLAST CLEANING machines with vacuum pick-up of abrasives and cleanings is the subject of a folder by Vacu-Blast Co., Inc. The folder describes and illustrates operating advantages and optional equipment.

Circle No. 311 on Reader Service Card.

EYE AND FACE protection equipment is featured in a 16-page catalog published by Sellstrom Mfg. Co. Catalog No. S-37 illustrates 57 different safety accessories.

Circle No. 312 on Reader Service Card.

ABRASIVE BELT swing grinders of all sizes and powers are featured in literature from the Grinding and Polishing Machinery Corp. Twenty different models to suit every use are illustrated.

Circle No. 40 on Reader-Service Card.

RESISTANCE WELDING literature featuring seam, spot, flash and chain welders and other resistance welding accessories is available from ASEA Electric, Inc.

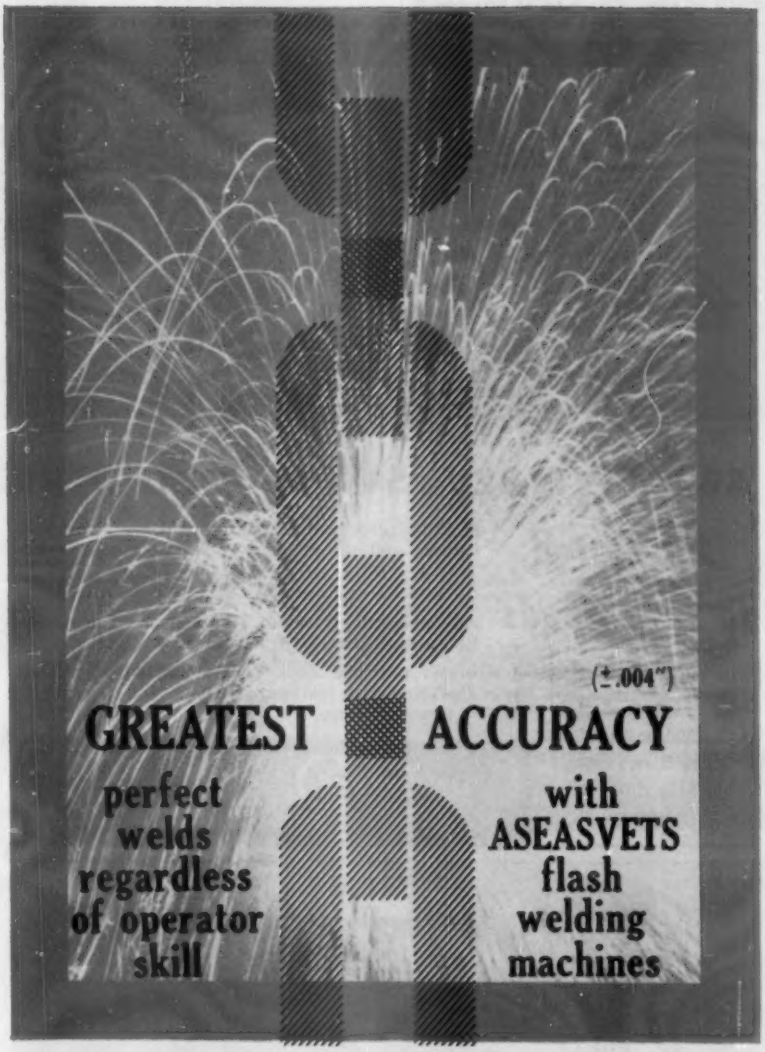
Circle No. 11 on Reader Service Card.

FREE FLUX SAMPLES are available from Krembs & Company, manufacturer of 25 different welding, brazing and soldering fluxes. Write for yours on company letterhead. Use Reader Service Card for literature.

Circle No. 49 on Reader Service Card.

KEYSEAT CUTTER to cut keyseats in ½ inch to 1½ inch shafts is described and illustrated in a brochure from Gary Steel Products Corp. This lightweight and portable machine slips on any length shaft to cut in seconds in tight quarters.

Circle No. 39 on Reader Service Card.



See why the SVU ASEASVETS Chain Welder is universally acclaimed wherever employed: welding of metal or alloy down to 1/100 of maximum welding section can be done without changing gears or cams. 100% tensile weld strength is assured even on high alloys. Clamping speed is high, clamping force low. No need to change welding dies to get concentric or eccentric welding variation. Welding capacities up to 40 square inches. Maximum clamping force 66 tons. Maximum upsetting force 44 tons. Other ASEASVETS welding machines include: Tube Welding Mills—for butt-seam welding. Seam Welders—foot and air operated for steel, stainless steel or non-ferrous metals. Projection Welders—for mass production of small and medium sized parts. Spot Welders—highly economical for materials usually soldered or riveted. Resistance Heaters—for bolt blanks. Electrodes—Ordinary, and with unusually deep penetration. Send coupon today, get the ASEA Welding Information you need.

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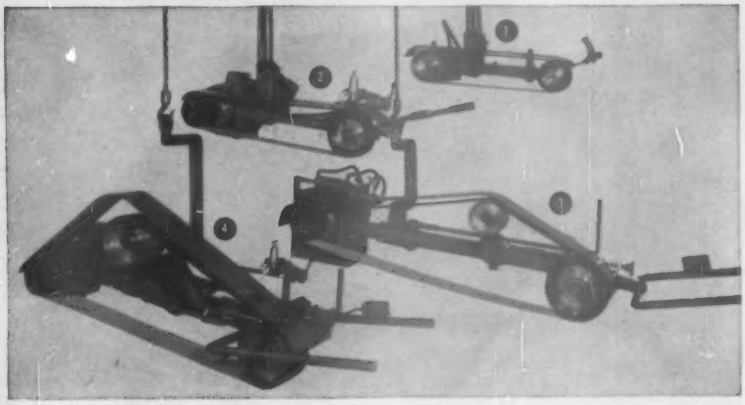
For More Information Circle No. 40 on Reader Service Card.



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A FULL LINE OF 20 STANDARD MODELS for ALL General and *most* specific production requirements.
1. G & P 6-72 Unit 2. Medium Duty Units
3. Heavy Duty Units 4. Xtra Heavy Duty Units

Available from 2 HP up. Air or Spring Tensioning. Belt sizes 2" thru 6" x 72" thru 132" long.

The *right* combination of size and power will fit YOUR job, whether *Weld Removal, Casting Clean Up or Polishing*. Belt Swings can SAVE you money.

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GV METAL WORKERS...

are preferred by more shops than ever!

Here are a few of the reasons:

- GV metal workers will cut practically any material within their capacity; such as mild steel, stainless steel, aluminum, brass, copper, fibre, etc.
- GV metal workers are precision made of the best Swedish steel. The mechanism is enclosed and operates in an oil bath.
- GV metal workers are made in 5 different sizes. Capacities 5/64", 5/32", 15/64", 5/16".
- GV metal workers are known for their durability, strength, service and simple maintenance.

You simply can't afford to be without at least one GV metal worker, because it pays for itself almost from the very start.

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For More Information Circle No. 45 on Reader Service Card.

A 20-PAGE BOOKLET published by the James F. Lincoln Arc Welding Foundation gives details for their $25,000 Award Program For Progress in Welded Design. The competition for welded designs of machines or structures closes July 17, 1961.

Circle No. 313 on Reader Service Card.

"METALS JOINING" is the subject of Brazing News No. 84 from Handy & Harman. In the issue are 12 case histories showing how tough joining problems were solved economically and effectively with silver brazing alloys.

Circle No. 314 on Reader Service Card.

STEEL FLANGES for oil producers, ship builders, pipe fabricators, and the chemical industry are featured in a 20-page, illustrated catalog from the Harrisburg Steel Co. The catalog contains specifications and charts for 150-lb. to 1500-lb. drop-forged steel flanges and welding neck flanges.

Circle No. 315 on Reader Service Card.

"DESIGN WELD ECONOMIES into Pads and Bosses" is the title of one of a series of weld design studies published by the Lincoln Electric Company. The illustrated study is punched for insertion in shop notebooks.

Circle No. 316 on Reader Service Card.

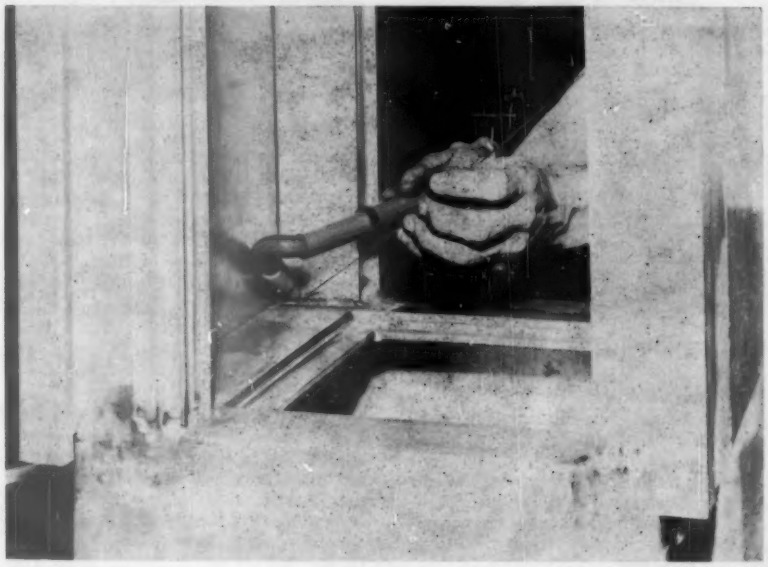
HIGH-TEMPERATURE ALLOYS are compared in a fact-and-data-filled, 20-page booklet available from Haynes Stellite Co. Compositions are given for 17 leading alloys, and their room- and elevated-temperature properties compared.

Circle No. 317 on Reader Service Card.

INDUSTRIAL REGULATOR with interchangeable stock parts is described and illustrated in literature from Modern Engineering Co. The regulator is designed for use with compressed air and all non-corrosive commercial gasses.

Circle No. 318 on Reader Service Card.

NEW PRODUCTS



Extendable Tig welding torch has controllable angle

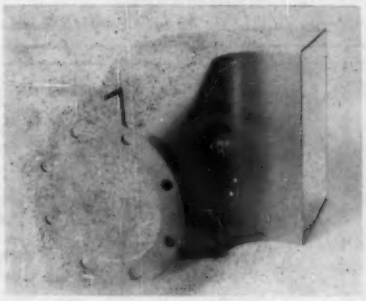
This torch was developed by the Falstrom Corp., a fabricator of aluminum, to make some of its own welding jobs easier. Now, the company is marketing it.

Fixed angle torches often hamper welding design. And, a fabricator must have a flock of different torches to handle the various welding situations he runs into.

This new torch is said to overcome these difficulties. Not only can its head be bent instantly to any angle—including doubling back to 180°—but it can be extended 6 inches beyond its normal length.

Previous attempts to make a torch with angular control have usually failed because of the effect of the torch heat on the head's mechanical joints. In the new torch, the copper cooling lines and copper gas lines are intertwined in the form of a helix. This rigid, yet flexible, core is brazed to the cooling head. The entire assembly is then molded and bonded with neoprene and inserted in a handle suitable for manual or machine use. The torch head thus is completely flexible and is enclosed in an insulated and heat-resistant body.

The torch is water-cooled, suitable for 180 amperes a.c.-d.c. continuous duty welding or 350 amperes a.c.-d.c. intermittent duty. Torches of other ratings are also available.



In the large photo above the operator extends the torch tip and angles it back to lay a bead on the inside corner where the vertical and horizontal supports of the aluminum cabinet meet.

In the smaller photo is another tough fabricating job licked by the torch. The compact duct is 18 inches high, 12 inches wide, and has a 90° bend. Its seams are welded and it's made from 5052H32 aluminum.

When the operator used a standard torch, his hands inside the duct blocked his view of the welding.

Using the controlled angle torch with the telescopic handle extended, the operator had full visibility of the welding operation.

Circle No. 37 on Reader Service Card.

Circle No. 43 on Reader Service Card.

"What's the secret of your strength, HERCULES?"
"No secret—I use only virgin alloys in my spotwelding tips and machine them with the best equipment money can buy."

Resistance Welding Alloys our only product. An abundant inventory of spotwelding tips and related accessories, as well as the various grades of copper-alloy bar stock, maintained at all times.

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LENCO, INC.
BOX 192, JACKSON, MISSOURI

Circle No. 50 on Reader Service Card.

Dial-Control Welder

An addition to the Twentieth Century Manufacturing Company line is a machine of many uses. Features include dial lifetime shunt control for setting any amperage; 80 open circuit volts for easy arcing; and high-temperature, break down-resisting insulation. Line includes seven models for standard and heavy duty service in 100 to 300 amp ratings.

Circle No. 225 on Reader Service Card

Silver Brazing Alloy

A new silver brazing filler metal has a flux core for faster, easier brazing. Air Reduction Sales Company is the first to use this idea. Called Aircosil Fluxcor 45, it is available in 70 to 80 oz. coils of 3/64th inch. The flux has good self-life and is self-sealing after cooling.

Circle No. 226 on Reader Service Card

Cutting-Duplicating Machine

The Milo Manufacturing Co. has announced a torch cutting duplicating machine. A magnetic roller, hand control, parallel guide, and graduated compass beam are used in the four cutting methods. They are: (1) cutting to sheet-metal template; (2) cutting direct from drawing; (3) circular cutting; and (4) straight cuts in desired direction.

The unit can cut .118" to 4" thickness. Cutting speed is regulated by a potentiometer and is indicated by a switchboard tachometer.

Circle No. 227 on Reader Service Card

Ultrasonic Foil Welder

A welder that can spotweld .00025- to .002-inch-thick foil without deforming the metal has been announced by Gulton Industries, Inc. The welder uses high-frequency vibrations instead of heat. The welds it makes are as strong as the parent metal.

Circle No. 228 on Reader Service Card

Inert Gas Welder

Welder, manufactured by Birdsell Div., Susquehanna Sciences, Inc., has 100% arc stability to permit welding the largest weldments down to the finest wire. The machine is fully resonated. It has four overlapping current ranges from ½ to 425 amps. Exotic metals of different sizes and weights can be welded. The design includes full power factor correction; phasing capacitors produce low line current at high welding currents.

Circle No. 229 on Reader Service Card

ROBVON BACKING RINGS

APPROVED FOR WELDING PIPE, VALVES, AND FITTING JOINTS

ROBVON TYPE "CCC" BACKING RINGS

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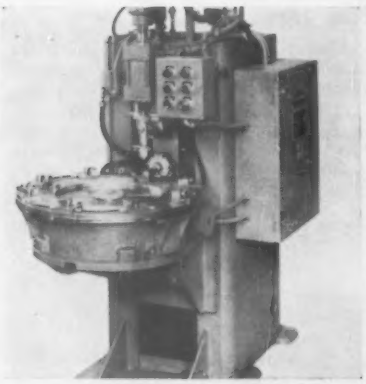
For More Information Circle No. 66 on Reader Service Card.



Indexing Projection Welder

A new, 8-station dial-indexing welder has been developed by Acro Welder Mfg. Co. to step-up subassembly production. The indexing table is driven by a Geneva motion motor. The welding head is low-inertia, anti-friction linear ball bearing diaphragm-type.

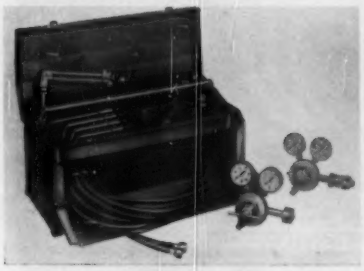
Circle No. 203 on Reader Service Card.

Self-Lighting Torch

An automatic, air-acetylene, battery-igniting torch for brazing, soldering and heating has been developed by the Prest-O-Matic Co., Inc. Pressing the control switch starts the gas which is instantly lighted by a battery powered circuit.

The torch comes equipped with three different size tips and uses two standard pen light batteries. It heats to 4,000°F with a clean flame.

Circle No. 204 on Reader Service Card.



Welding And Cutting Outfit

This complete medium-sized full capacity outfit has been announced by Marquette Manufacturing Company. Known as Redi-Pac, it includes full-size heavy duty gas regulators, full 25 ft. double line hose, four of the most useful welding tips, one medium-size cutting tip, and all accessories. It is designed to handle most welding lines; it welds all metals.

Circle No. 205 on Reader Service Card.

Selenium Cell Rectifier

A new rectifier, made by the Radio Receptor Company, Inc., operates at high currents without deterioration. Called Tri-Amp, the rectifier has no artificial barrier layer between the electrode and the counter electrode to impair cell efficiency and life. The rectifier has both the peak current and over-voltage capacities needed in welding.

Circle No. 206 on Reader Service Card.

Portable Welding Gun

A line of portable spotwelding guns, designed for high production and handling ease, has been developed by Kirkhof Mfg. Co. The C-type (shown) can be converted to the other types: Scissors, bell-crank, expansion and fixture-type units, with interchangeable components. Dotted lines show the bulk served by the compact retraction cylinder design.

Circle No. 222 on Reader Service Card.

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EMERSON ELECTRIC TIG-WELD 295

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The EMERSON ELECTRIC TIG-WELD 295 has built-in high frequency . . . permits Tungsten inert gas and manual stick electrode processes to weld Cast Iron, Rimmed Steel, Carbon Steel, Stainless Steel, Alloy Steel, Nickel, Copper and Copper Alloys, Aluminum and Magnesium. It's a complete welding shop in a compact package . . . fully rated 295 amps with currents as low as 13 amps.

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For More Information Circle No. 34 on Reader Service Card.

Automatic Arcair Torch

A heavy-duty, automatic Arcair torch was announced by the Arcair Company. It grooves seams and it prepares the edges of heavy plates for welding. Fast travel speed and low heat input allow little plate distortion. Unit consists of a tractor-driven automatic head, and Arcair Contactor with remote control switch. It uses copper-coated carbon-graphite electrodes.

Circle No. 207 on Reader Service Card.

Hard Surfacing System

A new hard surfacing system, Mir-O-Col Arc, has been developed by Mir-O-Col Alloy Co. A rotating graphite wheel is used to spark-rough a surface to be treated. Then, a mixture of carbides and matrix alloys are painted on the prepared surface, then welded.

Circle No. 208 on Reader Service Card.

Fabricating Tool

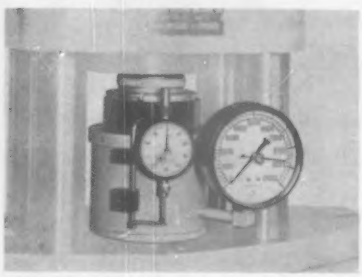
Complete fabrication can now be done with a single Heliarc torch. Linde Company, Division of Union Carbide Corp., has announced that most of their standard Heliarc welding torches may now be also used for Heliarc cutting (see photo). All shapes can be cut with equal ease. Tool helps to keep high speed and quality. Either manual operation or mechanical fixturing may be used.

Circle No. 209 on Reader Service Card.

Flux Jars

Fluxes manufactured by All-State Welding Alloys Company, Inc., now come in unbreakable plastic jars. The jars will be used for all but the most reactive fluxes. A wide-mouthed feature allows rapid flux dipping and application. Day Glow-type reflective labels will be used.

Circle No. 210 on Reader Service Card.



Converted Sheet Metal Tester

Result of over a year's work by Detroit Testing Machine Company is a self-contained adapter. This unit permits compression equipment to be used for ductility tests on sheet metal up to 1/16" thickness. Called Sheet Metal Tester Cell, it weighs 22 pounds. It may be used for ball punch and cup-type ductility tests.

Circle No. 211 on Reader Service Card.

CMD®

THE **chipping hammer** WITH **SWING BALANCE**

This is the hammer with the balanced feel—swings easy, fits the hand properly, absorbs shock. *Less fatigue* and it's a pleasure to use!

CMD heads are made of ¾" square tool steel. They can be re-sharpened right down to the shaft!

Type A 20 oz., drift and right angle chisel.
Type C 14 oz., drift and chisel.

TYPE A TYPE C

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For More Information Circle No. 26 on Reader Service Card.

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HARGRAVE
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WELDERS' CLAMPS

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Drilled Frame For Ground
Forged Steel

In 3 Patterns
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Heavy Duty

A SIZE AND PATTERN FOR EVERY JOB

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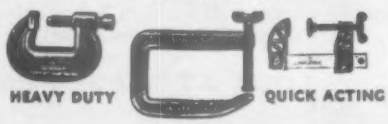
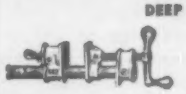
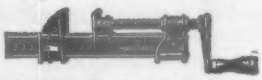


HEAVY DUTY DEEP REACH QUICK ACTING



CLAMP FIXTURES for ½" and ¾" pipe

BAR CLAMPS Light to Extra Heavy Duty



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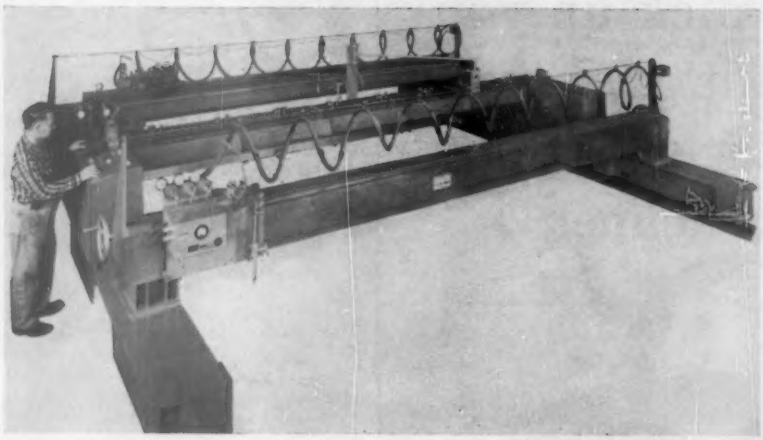

Gantry-Type Multiple-Head Flame Cutter

This low-cost unit handles plate up to 20 feet wide in any length. Made by Ty-Sa-Man Machine Co., it has an unlimited capacity for squaring large plate sizes, scarfing, beveling, and edge preparation to close tolerances. It can be converted into a straight-line automatic welding rig.

The cutter uses the standard Ty-Sa-Man saw gantry which is a production item with the company. The gantry unit is recommended for use with two end trimmers which also travel on the rails with the gantry and provide cross-cut trimming by means of a movable blow pipe which travels along the transverse rail on roller bearings. The gantry ripping unit can be fitted with up to eight variable angle blow pipes for multiple cutting.

Track travel consists of a Thy-Mo-Trol infinitely variable speed drive through a synchronizing cross shaft and a rack-and-pinion drive to each rail. Unit is pushbutton controlled with 100 fpm traverse rate.

Tracks are made from 100 lb. rail machined on top and sides and are available in any length.

Circle No. 212 on Reader Service Card.

Welding Tip Holder

The Air Reduction Sales Co. reports a new spot welding tip holder developed by the Tuffaloy Department. The new holder is of the paddle-type, designed for welding in confined areas. Holder comes with 4-inch offset and uses Tuffaloy socket-type tips.

Circle No. 14 on Reader Service Card.

Safety Eyewear

Mine Safety Appliance Co. combines safety with eye appeal in their new safety eyewear. Frames for the Sightgard line are available in acetate, metal, and acetate-on-metal. Acetate frames are combustion-resistant and metal frames are corrosion-resistant. Side shields are available in some styles.

Circle No. 213 on Reader Service Card.

DOCKSON GOGGLES
Your assurance of complete eye protection! Built for Better Service
COVER-SPECTACLE GOGGLES
Soft leather nose pad for protection and comfort.
Large plastic eye cups fit over all prescription glasses.
Screen or ray-proof metal side shields allow adequate ventilation.
Deep lens bezels for easy replacement of lenses.
MODEL 492 GOGGLES
MODEL 40 SPECTACLES
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Dockson offers a complete and varied line of low cost, maximum comfort goggles and spectacles for chipping, grinding, welding, and cutting. Their scientific design and outstanding workmanship make them the top choice of industry today.
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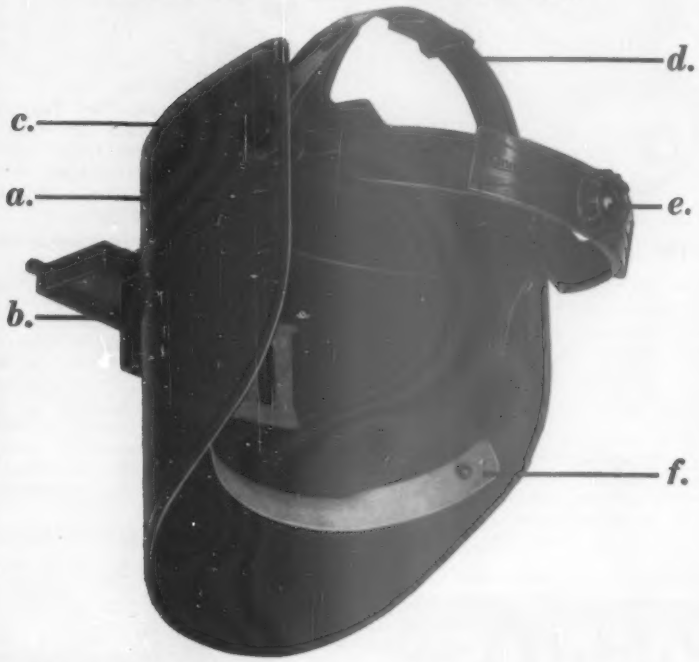
For More Information Circle No. 30 on Reader Service Card.

Next time you pick up your helmet...see if it gives you all the advantages of this OXWELD helmet



a. *One-piece seamless shell* molded from tough glass-fiber-reinforced polyester resin—lightweight, easily cleaned, strong, non-warping.

b. *Flip-front glassholder* die-cast from aluminum, stationary glassholder molded as integral part of shell for a light-tight seal.

c. *Fingertip tension adjustment* to hold helmet in up or down position. "CP" joints of durable plastic will not pass electric current.

d. *Adjustable crown strap* holds helmet firmly in choice of five positions.

e. *Rear knob* instantly adjusts headband size over wide range without need for removing helmet.

f. *Adjustable fiber chin rest* assures proper visual alignment and maximum comfort.

Compare these advantages with those offered by any other helmet. There are eight different types of OXWELD helmets and hand-shields. And each is designed with every advanced feature for maximum protection against infra-red and ultra-violet rays, sparks, and molten metal.

Comfort is a big factor. OXWELD helmets have been given the careful detailing that provides easy, instant adjustment, snug fit, and the "free-floating" suspension that eliminates pressure points. You can choose from three sturdy shell styles.

See them at your LINDE distributor's. Or write for literature and price lists. Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N.Y. *In Canada,* Union Carbide Canada Limited, Linde Gases Division, Toronto 12.

LINDE COMPANY

UNION CARBIDE

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For More Information Circle No. 52 on Reader Service Card.

Paste-Type Cleaner

A paste chemical weld area cleaning compound for easy, economical removal of oxide films without pickling has been announced by Eutectic Welding Alloys Corp. Eucleen compound removes chromium oxide heat tint from stainless and oxides from copper and copper alloys.

Eucleen compound is a combination of concentrated chemicals in paste form. It is daubed or painted on, allowed to remain for one or two minutes, and flushed off with plain water. Diluting with water reduces or eliminates disposal problems associated with acid pickle liquor.

No electricity is needed. The compound is available in 5, 10, 25, and 50 lb. containers.

Circle No. 214 on Reader Service Card.

Line Voltage Compensators

Heavy-duty voltage compensators capable of reducing 10 percent line voltage fluctuations to 1 percent are available from Glenn Pacific Corp. They are available for all single- or three-phase line voltages to 600 vac. The self-contained convection-cooled units with 100 percent duty cycle ratings to 400 KVA output per unit may be paralleled for higher capacities. Voltage regulation time response is adjustable; electronic sensing circuitry is available for applications requiring fast response with minimum output fluctuation.

Circle No. 215 on Reader Service Card.

New Power Supply

Hughes Aircraft Company's Vacuum Tube Products Division has developed a 500 watt-second stored energy electronic welding power supply. The VTW-33 has a range selector switch for fine control at low settings and an automatic lockout to prevent premature discharges.

Circle No. 216 on Reader Service Card.

Wheels Mount Fast

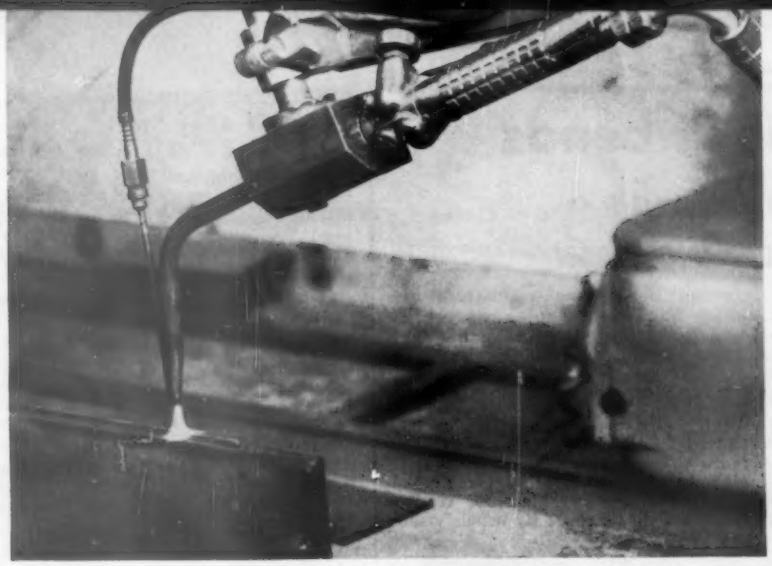
An improved Type 27 raised-hub grinding wheel with a unique mounting arrangement has been announced by A.P. de Sanno & Sons, Inc. The new hub consists of an adaptor flange and a threaded steel insert molded into the wheel. No tools are needed for mounting or dismounting.

Circle No. 217 on Reader Service Card.

Air-Tight Headgear

Willson Products has developed a new Tite Seal Headgear with only two adjustments. The gas mask is made of plastic and can be cleaned with soap and water. It will fit any head and is approved by the Bureau of Mines.

Circle No. 218 on Reader Service Card.



New Metal-To-Metal Surfacing Process

A new, versatile, and inexpensive metal-to-metal surfacing process has been introduced by Air Reduction Sales Co. The new Aircospray process was designed for hardsurfacing and brazing operations. It permits powdered metals to be sprayed and fused simultaneously on a base metal by means of an oxy-acetylene flame. This makes the process well suited for hardsurfacing—including deposition of powdered metals of a high melting point on a base metal of a lower melting point. When used with phosphorus or silver filler metals, Aircospray gives true capillary brazing (deep penetration) and permits placing the filler metal—combined with flux, directly on the joint area. It can also be used solely for metal spraying or for spraying subsequent to fusing.

Basic element of the new process is a standard oxyacetylene welding outfit with a modified torch tip that simultaneously permits passage of the oxy-fuel mixture and the powdered metal into the flame.

Accessories include a carrier gas source, a means of dispensing and carrying the powdered metals to the torch tip, and the necessary controls. Aircospray offers torch tips in three styles and a total of 15 models.

For More Information Circle No. 219 on Reader Service Card.

Pipe And Tube Rolls

Adjustable pipe and tube rolls are being produced by the Ransome Company. They feature rubber tires, roller bearings, and all-steel construction. Capacity is 1000 pounds; capable of handling cylinders from 2" to 36" in diameter. Unit has pilots for automatic alignment.

Circle No. 220 on Reader Service Card.

Welding Current Meter

Duffers Associates, Inc., Model 260 Current Meter is a portable, self-contained, self-powered instrument. The unit measures the root-mean-square value in 60 cps single-phase welder currents. Don't confuse it with meters that measure the rms of sinusoidal currents only.

Circle No. 221 on Reader Service Card.

Electric Welder

A new a.c. inert arc welder, designed by The Emerson Electric Mfg. Co., has a welding range of 13 to 295 amps. The welder's features include fully rated duty cycles for inert arc welding—40% at 200 amps, or 30% at 295 amps; electrically controlled gas and water valves; high frequency intensity control; direct or remote operation; post flow control and pilot light.

Circle No. 34 on Reader Service Card.

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It takes more than a line of welding equipment to be a LINDE distributor. It takes real knowledge of your welding needs . . . knowledge of local industry . . . practical experience and interest in efficient welding operations . . .

These are some of the qualifications that make your LINDE distributor so valuable to your business. He's a specialist in his field, equipped with a complete stock of welding and cutting equipment, industrial gases, welding rods, supplies, and accessories. They're all products of highest quality and proved efficiency. Your LINDE distributor is ready to help you today, with equipment, expert advice, and the benefits of LINDE's 50-odd years of welding and cutting leadership.

A telephone call will prove the point. Look up your LINDE distributor in the classified directory. Or write to Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada,* Union Carbide Canada Limited, Linde Gases Division, Toronto 12.

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Circle No. 53 on Reader Service Card.

For More Information Circle No. 46 on Reader Service Card.

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★The versatile Hossfeld Universal Bender makes hudreds of bends in round, flat or square bar stock, angle iron, pipe, tubing, and conduit. It's invaluable for maintenance, limited production work.

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This difficult bend in 4" flat stock was made easily, accurately.

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"IT'S THE SURFACE HARDNESS THAT COUNTS"

HARD-N-TUFF CORPORATION

Box 275a, Huntington, New York

For More Information Circle No. 42 on Reader Service Card.

Low-Cost Alloy Steel

Significant savings in the fabrication of stronger, lighter steel structures and equipment are promised by a new, low-cost constructional alloy steel, according to U. S. Steel Corp. Designated USS T-1 Type A steel, the new alloy is available in quenched and tempered plates and bars ranging from 3/16 to 1-inch-thick.

In this thickness range, the steel has the same 100,000 psi minimum yield strength as USS T-1 steel. Also, in thicknesses up to 1 inch, the new material and the original T-1 steel exhibit the same toughness, weldability, and resistance to impact and abrasion. However, the new T-1 Type A steel costs less because of differences in chemical composition.

Plates are available in all the widths, lengths, and qualities (including flange, firebox, and aircraft) currently furnished in T-1 steel.

Circle No. 223 on Reader Service Card.

Vacuum Cleaner

The new Model 140 Quik-Vac introduced by Clements Mfg. Co. Vacuums wet or dry, blows, air sweeps, or sprays. This industrial cleaner has a handy attachment carrier and a new, easy-grip handle. It coverts to a blower or a hand or shoulder-carried vacuum cleaner in seconds. Other features include two-speed power unit, two hose sizes, simple hookup and low current demand. A variety of general purpose attachments are available.

Circle No. 224 on Reader Service Card.

Heavy-Duty X-ray Machine

A new heavy-duty X-ray machine that produces images of unmatched sharpness has been announced by Picker X-Ray Corp. Sharper pictures are made possible by the tube's 0.012-inch (0.3-millimeter) focal spot, the smallest of any X-ray unit, the company explained. The unit has a rotating anode tube with a continuous rating of 6 milliamperes at 150 kilovolts, twice the output of a stationary anode tube.

Picker's technical director, John A. Reynolds explains: "Its controlled high-radiation output allows shorter exposures and the water-cooled tube permits handling of heavy traffic without overheating."

A counterweight 3-inch-square mast eliminates vibration. The mast can be pivoted 360° and fits under an 8-foot-high ceiling. The unit also has a telescoping tube arm that provides 16-inch cross-travel, and an axis for complete rotation of the tube hanger.

Circle No. 225 on Reader Service Card.

Hobart Technical School offers 5 short workshop courses

TROY, OHIO: Five intensive courses have been scheduled for the first part of this year by the Hobart Technical School. The courses are intended to help upgrade the ability of key personnel to direct, control, and evaluate fusion welding operations. Supervisors, inspectors, plant managers, welding foremen, and welding engineers will be exposed to advanced production techniques.

Each course will last five days. Text and a complete package of reference material will be furnished. This is the schedule:

January 9-13: Induction heat for the welding industry.

January 16-20 and May 8-12: Welding fundamentals for supervisors and engineers.

January 23-27 and May 15-19: Arc welding inspection and quality control management.

March 20-24 and May 22-26: Automatic welding for management.

April 24-28: Gas shielded arc welding processes.

Registration fee for each 5-day course is $50.00. Reservations may be made by contacting the School Director, Hobart Brothers Technical School, Troy, Ohio. Detailed information is available in a bulletin.

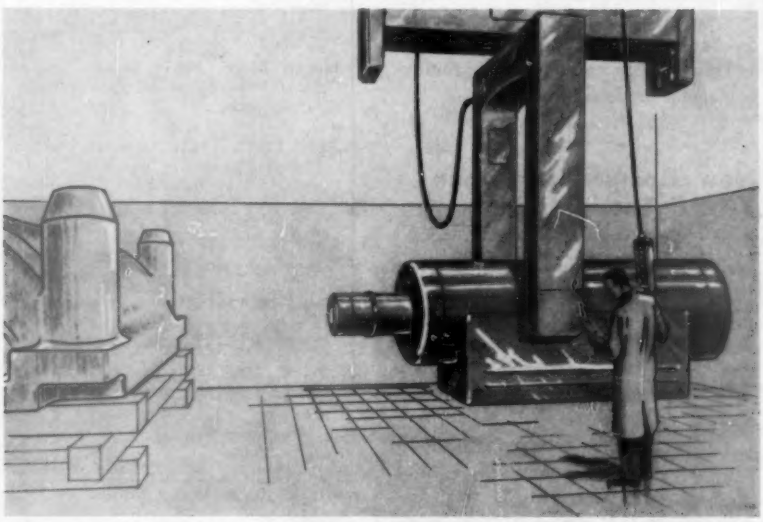
Curtiss-Wright Gives Two Training Courses

PRINCETON, N. J.: The Princton Division of Curtiss-Wright Corp. has set the date for two training courses on nondestructive testing. The first is on ultrasonic inspection techniques. It will be held January 23 through 27. The second, on industrial isotope radiography, will be held January 30 through February 3.

Details are available from Bruce W. Smith, Curtiss-Wright Corp., Box 110, Princeton, N. J.

Arcrods Expands Cleveland Plant

SPARROWS POINT, MD.: Work has begun on the expansion of the Cleveland, Ohio, plant of Arcrods Company, producer of welding electrodes and wires. The 50,400 square foot addition will cost about $800,000.



THE WORLD'S MOST powerful X-ray machine specifically designed for high speed radiography in the metals industry will be installed at the A. O. Smith Corporation's Milwaukee plant next spring. The eight million-electron-volt linear acceleration is now being built by the High Voltage Engineering Corp., Burlington, Mass. The "Linac" sees through steel more than a foot thick. It will be used on metal structures, such as core barrels for nuclear reactors and high pressure vessels for the petrochemical industry.

Circle No. 29 on Reader Service Card.

Photo Courtesy The Lincoln Electric Co.

NOW . . .
ONE AMMETER
for AC/DC WELDERS

Only TONG-TEST
measures both AC and DC

Weld with confidence. Use the exact amperage — no more, no less—to assure welding quality. Prevent costly rejects by controlling the welding current (AC or DC) with one TONG TEST AMMETER. Simply snap tongs around electrode cable — read amps instantly and accurately. No electrical connections required, cannot burn out. Interchangeable ranges up to 1000 amperes.

Write for Catalog IW-400

COLUMBIA ELECTRIC MFG. CO.
4545 Hamilton Avenue • Cleveland 14, Ohio

No Other Product Can Do a Galvanizing Job Like

Galvalloy

Does - HERE'S PROOF

Heat welded seam on galvanized sheet to 600° with Torch

Rub GALVALLOY against heated surface as shown — now spread with wire brush for a bright finish.

GALVALLOY Covers the Same Amount of Area with 1/5 the Amount of Material.

Send today for Testing Sample and you'll learn Why GALVALLOY has no equal for ANY Galvanizing Job.

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62 years of experience in scientific development in welding

Whatever the particular job you have to do—we have the right FLUXINE you need. Besides our 25 FLUXINES we carry a complete line of "KOP-R-ARC" coated rods for welding copper and all copper alloys.

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(Est. 1875)
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up to 2200° F.

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MODELS K3 & M2
BLOWTORCHES

Here are rugged, high efficiency blowtorches that speed up all types of heat treating and production operations. These two Clements Cadillac Blowtorches provide heat up to 2200°F. in seconds and are fully portable.

With the Clements Cadillac model K3 or M2 you can bring the torch to the work instead of the work to the torch as in fixed installations. Furnished fully equipped with 20 ft. of Underwriters' Laboratories and Canadian Standards Association approved 3-wire cable with plug, 10 ft. of gas hose with fittings ready to attach to your gas line and with sturdy, high stability stand. Easily adjustable for height and direction of torch.

Operates on natural, manufactured, or LP-gas.

CLEMENTS MFG. CO.
6646 S. Narragansett Ave., Chicago 38, Ill.
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INDUSTRIAL PRODUCTS DIVISION

See us at Booth No. 556—National Plant Maintenance & Engineering Show.
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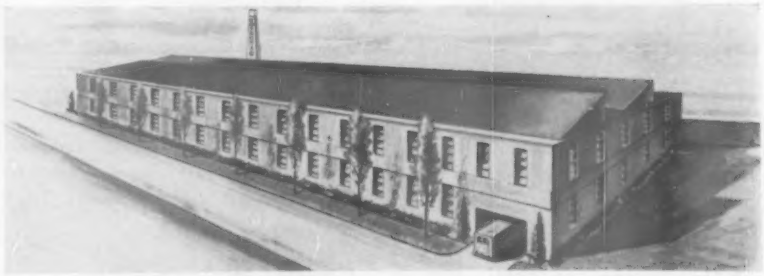

METALLURGICAL CENTER to be built by Eutectic will cost $2.5 million and will cover 100,000 square feet.

CORNERSTONE of new administration building will contain copies of WD&F deposited here by Tom Dempsey, publishing director. R. D. Wasserman, Eutectic's president, looks on.

Eutectic Plans New Metallurgical Center

FLUSHING, NEW YORK: Eutectic Welding Alloys Corp. has revealed plans to construct a metallurgical plant and research center at its headquarters here in 1962. The announcement was made by by R. D. Wasserman, president, at a luncheon marking Eutectic's 20th anniversary.

The ceremonies also included welding into place of a metal cornerstone for a new administration building and the introduction of several new products. These included a chamfering and grooving electrode which can operate on a.c., as well as d.c., and a chemical paste compound for removing metal oxide films.

New Competition Open To All Shop Students

CLEVELAND, OHIO: All high school students will be eligible for the first time to compete in a national welding competition sponsored by The James F. Lincoln Arc Welding Foundation. The announcement was made by Charles G. Herbruck, Foundation secretary.

Formerly, only vocational agriculture students were eligible. A total of $7000 in cash awards was distributed in that division. This competition was so popular it was expanded to include non-farm boys. Separate divisions—agricultural education and industrial education—have been set up. Cash awards of $7500 will be made this year in each division.

Closing date for entries is June 12, 1961. Details can be obtained from the Foundation at Cleveland 17, Ohio.

COMING EVENTS

January 23-26, 1961: Plant Maintenance & Engineering Show, International Amphitheatre, Chicago.

February 1-2, 1961: 7th Midwest Welding Conference, Armour Research Foundation, Illinois Institute of Technology, Chicago.

March 20-24, 1961: 12th Western Metal Congress and Exposition, Pan-Pacific Auditorium, Los Angeles.

March 24-25, 1961: Kansas Welding Show, Wichita Section, A.W.S. Wichita, Kansas.

April 17-21, 1961: American Welding Society Convention and Welding Exposition, Sheraton-Atlantic Hotel and New York Coliseum, New York City.

April 24-25, 1961: International Acetylene Convention, Boston.

May 8-10, 1961: National Welding Supply Association Convention, New York City.

Data Offered in This Month's Ads

Readers may obtain any of these free reference materials by circling the corresponding numbers on the Reader Service Cards

1-10: Ten pieces of literature on welding are available. Circle the appropriate number for literature desired. **McKay Company.**

11: Resistance welding booklets are offered. **ASEA Electric, Inc.**

12: Hold-down clamps with shielded screw are illustrated. **Adjustable Clamp Co.**

13: Tungsten-inert-gas torches are featured. **Air Reduction Sales Co.**

14: Spot welding tip holders and electrodes are described in a catalog. **Air Reduction Sales Co., Tuffaloy Dept.**

15: Aluminum manual is offered. **All-State Welding Alloys Co., Inc.**

16: Hard surfacing products are featured. **Alloy Rods Company.**

17: Goggles with increased protection and comfort are described and illustrated. **American Optical Co.**

18: Cable connectors are listed in a bulletin. **Ampco Metal, Inc.**

19: Band saw design and operation are described. **Armstrong-Blum Mfg. Co.**

21: Carbon arc gouging using Keen-Cut electrodes is featured in material. **Becker Brothers Carbon Co.**

20: Belt grinder that is air-powered is featured. **Aro Equipment Corp.**

22: A punch-and-shear for metal under ¼-inch thick is featured. **Bateman Foundry & Machine Co.**

23: Shallow draw press is described in literature. **Cyril Bath Co.**

24: Receptacles and plugs in many sizes and designs are featured in a catalog. **Camlok Div., Empire Products, Inc.**

25: Oxidation and scale removal is subject of bulletin. **Chemclean Products Co.**

26: Chipping hammers in seven styles are described in a brochure. **Chicago Mfg. & Distributing Co.**

27: Clamps for all jobs are described in catalog. **Cincinnati Tool Co.**

28: Blowtorches which operate on natural, manufactured, or LP gas are described. **Clements Mfg. Co.**

29: A tong-type a.c./d.c. ammeter is featured in material. **Columbia Electric Mfg.**

30: Safety goggles are featured in literature. **Dockson Corp.**

31: Electrode holders are featured. **Duro Engineering Co.**

32: X-ray film for radiographic film is featured. **Eastman Kodak Co.**

33: Low-frequency induction heating is the subject of a brochure. **Electric Arc, Inc.**

34: One welder for Tig or manual stick electrode welding is described in selector guide. **Emerson Electric.**

35: Arc welding accessories and welding circuits are described. **Erico Products Inc.**

36: Electrodes for arc gouging and cutting are featured. **Eutectic Welding Alloys Corp.**

37: Controlled angle torch for tungsten inert gas arc welding is described in catalog WC-60. **Falstrom Co.**

39: Keyseat cutter is featured in literature. **Gary Steel Products Corp.**

40: Belt grinders for grinding and polishing in one operation are described. **Grinding and Polishing Machine Co.**

41: Axle assemblies, jacks, couplers, and spindles are illustrated in catalog. **Hammer Blow Tool Co.**

42: Hardening of wearing parts is featured. **Hard-N-Tuff Corp.**

43: Resistance welding alloys and tips are featured. **Hercules Welding Products Co.**

44: Automatic welding processes are featured in bulletin HW-11. **Hobart Brothers.**

45: Metal workers made in five sizes are described in literature. **Homestrand Machine Tool Corp.**

46: Iron benders available with 147 dies are featured in a bulletin. **Hossfeld Mfg. Co.**

47: Flux recovery systems are described in a folder. **Invincible Vacuum Cleaner Mfg.**

continued on page 84

Get the lion's share of meaty facts out of this issue of WELDING DESIGN & FABRICATION before you pass it along to the next reader. Leaf through once more: If you want full details on any item, the Reader Service Card will bring them to you quickly. No postage needed.

the **ARC-TWIN**

***Double Notches* Pipe and Tubing with *Each Downstroke* of Punch Press!**

PATENTED

SAVING both time and cost, it gives you perfect T-joints—instantly ready for welding or brazing without deformation or finishing! Twin-acting punch shears clean, from inside out, leaving two matching notches (in perfect 180° alignment) with every downstroke of the punch press. Quickly interchangeable dies and punches accommodate pipe and tubing from ½" to 2⅛" O.D.; special units, up to 3" O.D.

Special Arc-Twins for double notching stainless steel or monel metal and units built to your specifications can also be furnished.

Ask for twin-notched sample of pipe or tubing.

VOGEL TOOL AND DIE CORPORATION
1819 North 32nd Ave. • Stone Park, Ill.

For More Information Circle No. 72 on Reader Service Card.

DATA FEATURED IN ADS

continued from page 83

48: Electrode holder with sealed cable connection is described. **Jackson Products.**

49: Flux sample and chart are available. **Krembs & Co.**

50: See your welding distributor about welding supplies. **Lenco, Inc.**

51: New three phase rectifier d.c. arc welder is described and illustrated. **Lincoln Electric Co.**

52: Welding helmets (eight different types) are featured. **Linde Company.**

53: Welding distributors and how they serve local needs is described. **Linde Co.**

54: Magnetic particle inspection is featured. **Magnaflux Corp.**

55: Facilities, capacities and new fabricating techniques are featured. **R. C. Mahon.**

56: Pipe center finder with automatic punch is featured. **Manning Mfg. Co.**

57: Galvanizing welds is the subject of information which includes a sample. **Metalloy Products Co.**

58: Wire gun and powder gun hard-facing is described. **Metco, Inc.**

59: Portable and stationary welders are described and illustrated in a booklet. **Miller Electric Co., Inc.**

60: Portable electric tools are featured. **Milwaukee Electric Tool Corp.**

61: Subcontracting of precision and heavy weldments is described. **Morgan Engineering Co.**

62: Welding wire is featured in folders DH-402 and DH-1218. **Page Steel and Wire Div., American Chain & Cable Co.**

63: Portable x-ray unit is described and illustrated. **Picker X-Ray Corp.**

64: Renting vs. buying of positioning equipment is explained. **Ransome Co.**

65: Welder control planning is described in bulletin SM-277. **Square D Co.**

66: Backing rings for pipe welding are featured. **Robvon Backing Ring Co.**

67: Tractor grouser bars and other high alloy stock are listed. **Stulz-Sickles Co.**

68: Torches with transparent nozzles are described in literature. **Tec Torch Co., Inc.**

69: Electrodes for resistance welding are featured in a catalog. **Tipaloy, Inc.**

70: Temperature indicating crayons with 80 different ratings are featured in literature. **Tempil Corp.**

71: Combination welding and cutting units are described in literature. **Victor Equipment Co.**

72: Double notching pipe and tubing is featured. **Vogel Tool & Die Corp.**

73: Controls for brazing alloy flow are described in literature. **Wall Colmonoy.**

74: Manifolding cylinder pigtails are featured. **Western Enterprises, Inc.**

75: Temperature indicating crayon in adjustable metal holder is described in brochure. **Markal Co.**

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Cost of all ads in this section is $20 for the first inch and $15 for each additional inch or fraction. Rates for display ads in this section will be sent on request. All classified advertising payable in advance.

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Fully Guaranteed Materials
Meets all Gov't, AWS, ASTM Specifications.

Low Fuming Bronze Rod—Aluminum—Nickel Silver—Silver Solder—Flux—Phos Sil 0,2,6,15 Alloys

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Complete or brush up courses in oxy-acetylene welding & cutting, Manual Arc, TIG, Automatic, Pipe (up & downhill) sheet metal, etc. Precode test training. Request bulletin from—

HOBART WELDING SCHOOL,
Box HW-111, Troy, Ohio

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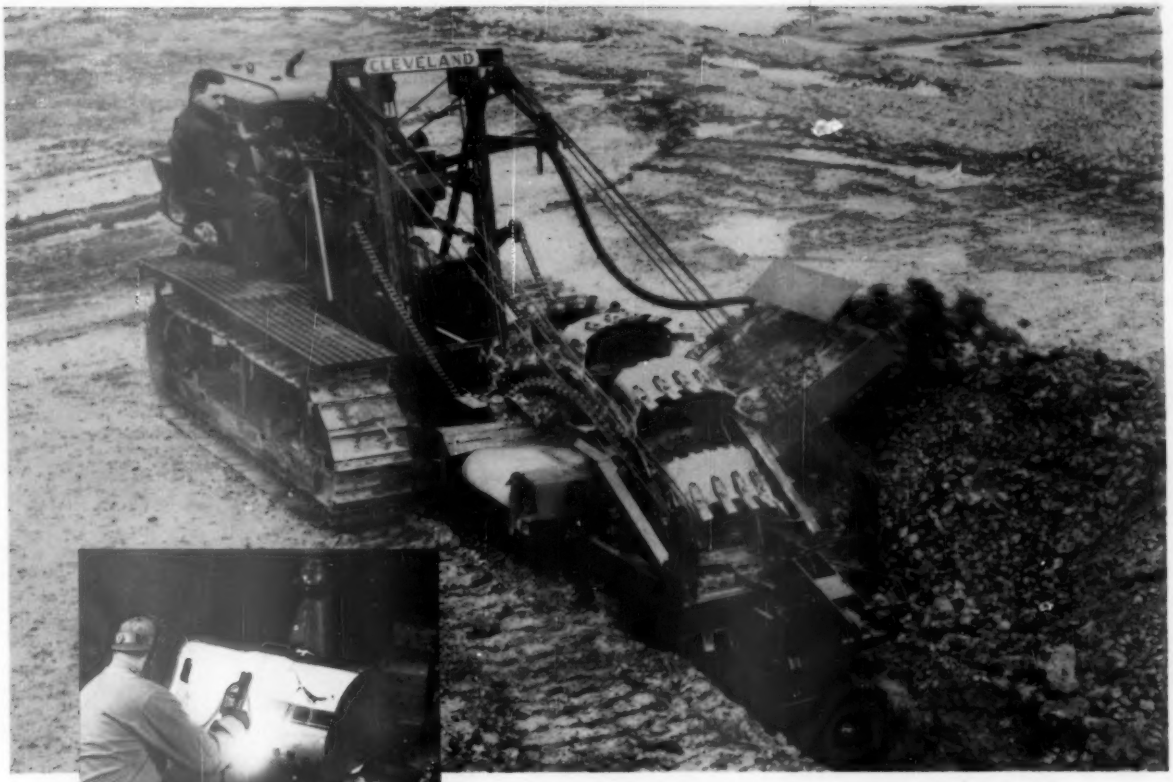

CADDY Type K-45 (400 Amp.) ELECTRODE HOLDER and E-60-12 electrode used to join the segments of the digging wheel rims for the Model J-40 CLEVELAND TRENCHER —Cleveland Plant.

CLEVELAND TRENCHER

uses CADDY

ARC WELDING ACCESSORIES

CLEVELAND TRENCHER COMPANY (Cleveland, Ohio), world's leader in manufacturing trenching equipment uses arc welding as a method of construction for their entire line of trenchers.

Low hydrogen rod is used for joining the segments of the digging wheel rims. Hard facing rod is then used on the inside diameter of the digging wheel. The lugs for the digging buckets are first tack-welded and then seam welded. Even the chassis is completely welded.

Building the CLEVELAND TRENCHERS rugged enough to withstand the continued wear on the buckets and entire trencher demands quality construction and the production department demands peak efficiency on all manufacturing equipment.

Besides the CADDY Type K-45 ELECTRODE HOLDER, CLEVELAND TRENCHER is standardized on complete CADDY arc welding circuits. These circuits include: ground clamps, quick connectors, lugs and splices, all connected to the welding cable by the CADWELD CONNECTION. The CADDY circuits surpassed all competition for continued rugged performance and cool operation.

CADDY® Arc Welding Accessory Div.

Erico Products, Inc.

2070 E. 61st Place • Cleveland 3, Ohio

IN CANADA: ERICO INCORPORATED, 7 Superior Ave., Toronto 14, Ontario, Canada

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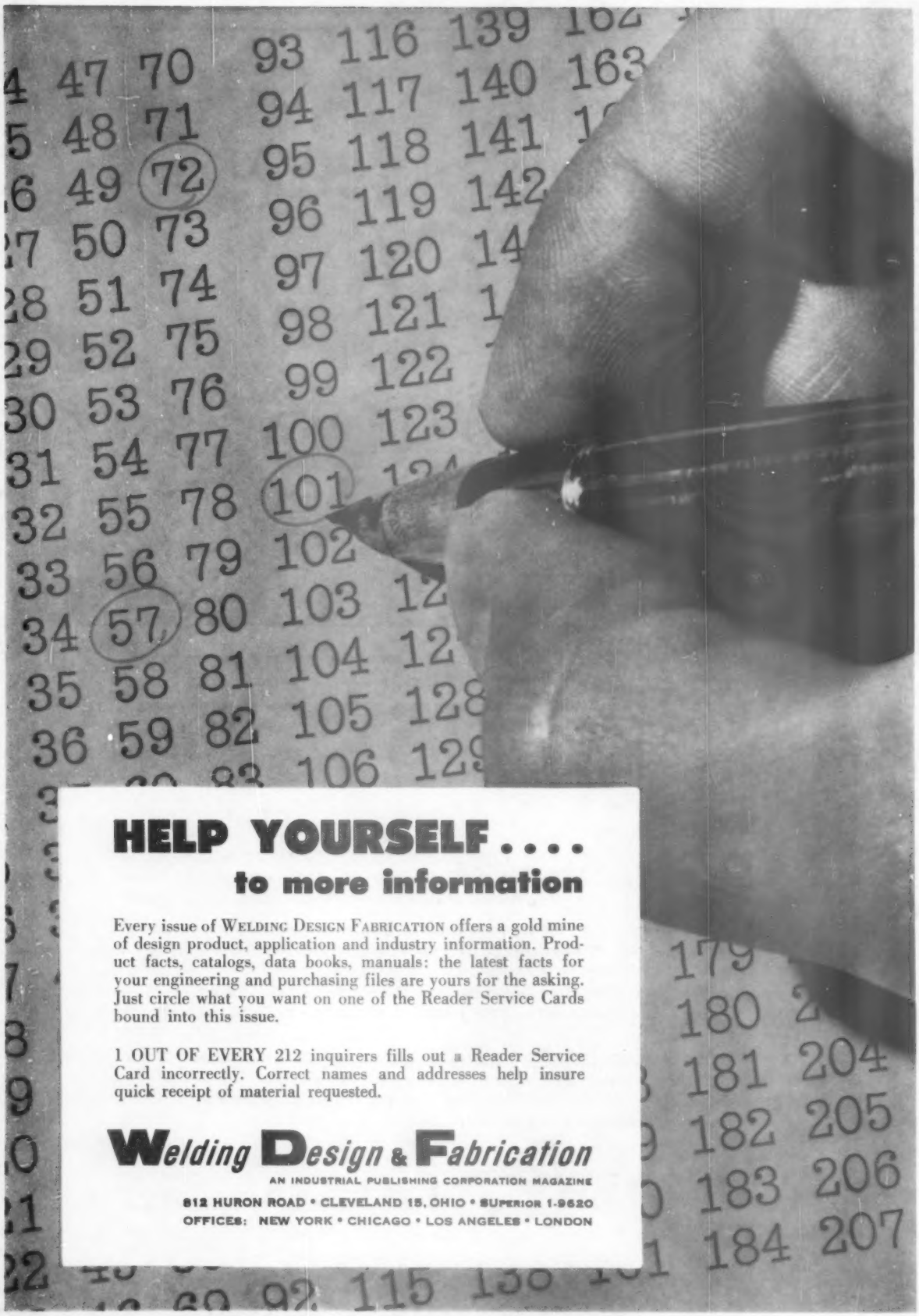
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